The Dock & Harbour Authority

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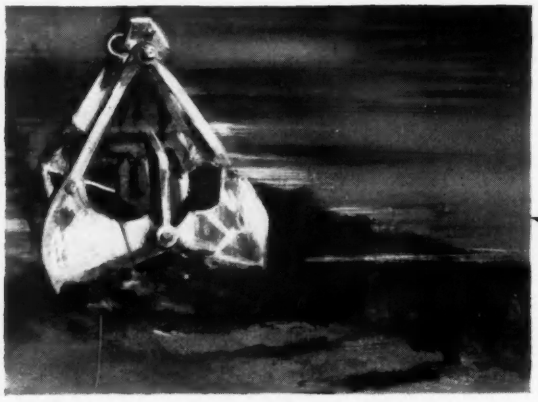

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The Dock & Harbour Authority

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No. 451

Vol. XXXIX

MAY, 1958

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Editorial Notes

Skarvik Oil Jetty, Gothenburg

One of the Editorial Comments in the May, 1957 issue of this Journal expressed our intention of including further information regarding the proposals of certain port authorities on the question of accommodating the modern supertanker. Our leading article this month on the Skarvik Oil Jetty at Gothenburg describes the design and construction of new berthing facilities which, although too small for the largest vessels now building, will accommodate tankers of up to 45,000 deadweight tons and 37½-ft. draught. These facilities are designed for the reception of refined products rather than for the importation of crude oil to a refinery, and tank farms have been erected to the rear of the jetty by the marketing organisations of various oil companies.

The article describes in some detail the methods of construction and concreting procedure, site work having been carried out between October 1955 and April 1957. The jetty design, which has points of similarity to that of the main jetty of the Oil Port of Stockholm, takes advantage of the low tidal range obtaining on the Swedish coastline.

Matters of technical interest include details of the two types of piling used. Relatively short 18-in. x 18-in. reinforced concrete piles which were driven on a rocky formation nearer the shore line, were provided after driving with rock shoe points, and the inner portion of the jetty is designed as for piles pin-jointed at their bases. The outer portion of the jetty is founded on long friction piles of composite timber and reinforced concrete design, the timber portion being buried at least 8-ft. below the dredged depth. These piles are provided with ice protection. A further point of interest is the design of the high capacity fender units, each capable of absorbing 160-ft./tons of the energy of a berthing vessel. Under these conditions the compression of the unit is 20-in., the ultimate thrust transmitted to the jetty by the fender being 215 tons. The energy is absorbed by 16 rubber cushioning blocks fixed to an arrangement of steel struts and bracings with means of pre-compressing the assembly prior to transportation as a complete unit. The total cost of a unit is stated to be only about £3,000 and at this rate the considerable maintenance costs associated with exposed steelwork under working conditions between " wind and water " appear to be justified.

The Skarvik jetty was designed by the Technical Department of the Gothenburg Port Authority and all concerned are to be commended for a practical and inexpensive form of construction.

Flexible Dolphins

In this issue we print the first instalment of an article on Flexible Steel Dolphins by Ir. Tj. J. Risselada, Chief Engineer of the Amsterdam Harbour Works Department, in which he reviews recent Dutch developments in this field.

There is a great ferment of ideas on the design and construction of dolphins and kindred structures among harbour engineers all over the world. In complete contrast to the concepts of previous generations, the emphasis has everywhere been on flexibility, examples being berthing beams, steel pile cantilever clusters, bell dolphins, buoyancy rings and many devices using springs and rubber. The great increase in the number of bulk loading terminals, particularly for the mineral and petroleum trades, often far from established harbours, has provided this new challenge to engineers, and we hope that Mr. Risselada's articles will be of direct assistance in this direction.

Newport Docks Exhibition in Birmingham

An exhibition publicising Newport Docks was held in Birmingham from 29th April to 2nd May, 1958. Sponsored by Newport Corporation, the five-day docks and industry display was held in the Exhibition Hall of the Birmingham Chamber of Commerce, and was organised to replace the display presented each year when the British Industries Fair was held at Castle Bromwich.

The object of the recent exhibition was to draw the attention of industry to the facilities available at Newport for the expeditious handling of cargo—speed of turnround being claimed as a special feature of the port's efficiency. The docks are located only 90 miles from Birmingham and therefore constitute a natural outlet for the export of a substantial share of goods manufactured in the Midlands.

This drive for more trade has been given impetus by the modernisation programme planned by the British Transport Commission and which is now in hand. Costing over £1 million, the main items include the construction of two new transit sheds, which will increase the transit shed floor area to over 250,000 sq. ft. Improvements are also to be made to the road and railway systems which comprise some 109 miles of rail tracks and five miles of roadways. New equipment will include electric quayside cranes, mobile cranes and ancillary mechanical handling appliances.

A full description of the Port of Newport and of the improvements planned appeared in the August 1957 number of this Journal and, on page 19 of this issue we are publishing details of the new Tanker Discharge Dock which has been constructed for Shell-Mex and B.P. Ltd., and which has now been brought into service.

Implications of the Growing Use of Atomic Power

Hardly a week goes by without reference being made to the hazards attendant on the widespread use of nuclear power. Readers will recall that we made brief mention in our February 1958 issue to two authoritative papers recently read on the subject. Attention has again been drawn to the safety aspect of the

Editorial Notes—continued

use of atomic power in ships, this time on the opening day of the International Labour Organisation's maritime conference held in Geneva early this month.

Mr. Tom Yates, chairman of the general council of the Trade Union Congress and general secretary of the National Union of Seamen, tabled a resolution proposing protection for seafarers in ships propelled by atomic power or carrying radioactive materials. It was stated that it would obviously be necessary to have international agreement on safety, as ships traded in the waters of many countries. Dock authorities would require very specific assurances that an accident would not require the closing of a port. The effects of radiation, whether by accident, stranding or malfunction of equipment would have to be studied, while the effect of radiation on cargoes and the effect of radioactive discharge into the sea were other problems that would also need settlement.

Another aspect of the use of atomic energy was emphasised recently when a conference on atomic energy insurance was held in Paris, at which six countries were represented. The meeting was held to discuss the resolution that " It is essential that there should be agreement between pools concerning (a) the minimum information necessary for purposes of hazards evaluation; (b) the bases of rating; and (c) policy covers."

It is apparent that there is a growing realisation of the numerous problems concerned with and stemming from the use of atomic energy, and it is to be hoped that with their repeated ventilation throughout the world, satisfactory solutions and precautions will be formulated.

New Ship-to-Shore VHF Services

The General Post Office has recently announced that work has started on providing a new VHF ship-shore service from North Foreland. It is expected that this service will be opened about the end of August 1958, and will then provide radio-telephone communication between suitably equipped ships in the sea areas around North Foreland and any telephone subscriber in the United Kingdom. The shore equipment will be installed at, and calls handled by, the existing Post Office coast radio station at North Foreland. It is expected that the radius of the service area will be about 40 miles over a continuous sea path. The range will be partly dependent on the height of the ship's aerial and radiated power, but the latter is limited to 20 watts by international agreement.

The equipment at the coast station and on ships will comply with internationally recommended technical characteristics and will use frequency modulation. A specification has been agreed in the United Kingdom for ship station equipment in accordance with these characteristics. Two separate channels will be provided at the coast station—a single-frequency calling channel on 156.8 Mc/s, and a two-frequency traffic channel using 161.9 Mc/s for transmission and 157.3 Mc/s for reception. These frequencies were internationally agreed at the Hague Maritime VHF Radiotelephone Conference for services of this kind.

The new service will be open to ships of all nationalities, and will be similar to that opened for the Firth of Clyde in May last year. Calls in the Clyde service are, however, handled by a telephone exchange and a separate calling channel has not yet been fitted. Further VHF services are being planned from the existing coast radio station at Niton (Isle of Wight), Humber (Mablethorpe) and Lands End. It is hoped that these services will all be in operation by the middle of 1959, but the service at Niton may be open early in the year.

At the same time, it is interesting to note that the Melbourne Harbour Trust has become the first port authority in Australia to be granted a licence for operation of shore-based equipment for communication in the International VHF maritime radiotelephone service. The frequencies being used are 156.8 and 156.6 Mc/s for Safety, Calling, Harbour Control and Port Operation respectively. The service will come into full operation shortly, following the erection of permanent masts at Melbourne and Williamstown. Lines are being provided between these two locations to facilitate remote control of the apparatus, thus ensuring that the service will be manned on a continuous basis.

Visit of New York Officials to Liverpool

During his visit to Liverpool, Mr. Donald V. Lowe, chairman of the Port of New York Authority, who has been on a brief visit to Great Britain as part of his European tour, was particularly interested and impressed by the reconstruction and improvement works now in hand at the port of Liverpool for the Mersey Docks and Harbour Board.

Mr. Lowe and members of the New York port development staff who were with him, drew attention to the dissimilarity in dock working practice between the two ports. He was particularly struck with the use made of quay cranes in Liverpool, and pointed out that in New York the general practice was for ships to use their own gear. On the other hand, in the American port more extensive use was made of fork trucks than on the Merseyside, where small mobile cranes were employed on the quays and in the dock sheds.

These variations in cargo handling methods show the difficulty of attempting to apply a general standard to all ports. Customs differ from country to country and, indeed, from port to port in any one country. Standardisation may seem a desirable ideal, but local circumstances have to be taken into account. Such visits as that of Mr. Lowe should stimulate interest, and enable port operators to gain first hand knowledge of the problems facing other authorities.

Hydraulics Research Board Chairman

Mr. G. A. Wilson, M.I.C.E., Chief Engineer to the Port of London Authority, has accepted the invitation of the Council for Scientific and Industrial Research to become Chairman of their Hydraulics Research Board for the five years commencing 1st April, 1958. The preceding Chairman was Mr. W. P. Shepherd-Barron, M.C., T.D., Past President of the Institution of Civil Engineers.

The Hydraulics Research Station is one of the more recently created research establishments of the Department of Scientific and Industrial Research, and while it still has a long way to go before it rivals in size similar stations in France, the Netherlands and the United States, it has already an international reputation and its annual earned income is considerable.

It would be easy to use the current demand for solutions to hydraulic problems on coasts, estuaries and rivers and canals to extend the commercial activities of the Station, and it seems likely that one of the vital questions which the Hydraulics Research Board will have to decide in the next few years is the extent to which basic research should be given precedence over practical investigations to solve engineering problems.

The choice of Mr. Wilson as the Chairman of the Board is to be commended because it follows the policy reflected in the annual reports emanating from the Stations of the Department of Scientific and Industrial Research where a linking of the research programmes with the needs of industry is regarded as essential for well directed research and for the early application of the results.

The Port of London Authority during the Chairmanship of Lord Waverley not unnaturally sponsored a good deal of research and the Chief Engineer has worked with the research teams and also applied the results for the benefit of the Port.

New Award by Institution of Structural Engineers

The President of the Institution of Structural Engineers has announced the establishment of a new award to be associated with the name of Major R. F. Maitland, who has been Secretary of the Institution since 1930. A lecture to be known as " The Maitland Lecture " has been instituted and will be competed for annually by Members and Associate-Members of the Institution. The subject of the Lecture may be on research, design or construction in the field of structural engineering, with special reference to new developments. The winning lecture will be presented at an Ordinary Meeting of the Institution and the winner will receive the Maitland Silver Medal and the premium award of £100. The Lecture will be given for the first time during the Session 1958-9, which is the Institution's Fiftieth Anniversary Year.

Skarvik Oil Jetty, Gothenburg

Description of Recently Completed Construction Works

(Specially Contributed)

THE Eastern Jetty of Skarvik in Gothenburg's harbour was officially opened on the 2nd of July, 1957, thus completing the first stage in providing Sweden's largest port with completely new and up-to-date facilities for importing oil. When completed, Skarvik Harbour will consist of two oil jetties in 40-ft. depth of water and a distribution quay for smaller vessels, all protected by a breakwater (see Fig. 1). The tide in these waters is negligible. Each jetty will be able to accommodate two discharging oil tankers at a time. Various oil firms have already built tank farms and pumping installations, and at a later date the harbour will be provided with a cleansing plant for the treatment of waste oil from the tankers and so prevent the undesirable practice of cleaning out the tanks whilst at sea.

Skarvik Harbour lies at the mouth of the River Göta and is therefore somewhat exposed to the elements. South westerly storms can produce severe high water conditions with waves running 3-ft. high and in addition, very strong currents occur from time to time. The surrounding terrain is flat and consists of old mud-fill in what was once a small bay. At the river bank, rock bed level lies approximately 33-ft. below water level, but dips rapidly so that it lies at a depth of over 200-ft. at the outer end of the jetty. Over the rock lies a layer of gravel and sand which again is covered by a deep layer of the unique loose "Gothenburg Clay."

The newly completed Skarvik Jetty is the first of the two oil jetties. It was designed by the Technical Department of the Gothenburg Port Authority and the contract was awarded to Messrs. Christiani & Nielsen, Ltd., Sweden, in October, 1955.

The jetty extends 900-ft. into the river and is symmetrical about its centre line, with provision for berthing and discharging one tanker on each side. The jetty is divided into the following sections: first a land connection bay approximately 30-ft. long provided with two 120-ton and one 75-ton bollards; then comes the approach jetty with roadway and pavement leading to the breasting island which is the main part of the jetty. Finally a catwalk connects the breasting island to the mooring dolphin on which are two 120-ton and two 50-ton bollards (see Fig. 2).

The oil is pumped through several pipes of which the largest has a diameter of 20-in. These pipes run from the breasting island at deck level into a pipe trench on land. The connecting hoses between the tankers and the jetty are handled by crane from the breasting island.

With the exception of the catwalk, which is a steel framework, all sections of the pier above water are constructed of high quality reinforced concrete.

The pier has been designed for impact loads and bollard loads resulting from tankers of up to 45,000 tons deadweight. Because of the poor sub-soil conditions, the transfer of these considerable forces to the river bed was the subject of exhaustive studies at the Technical Office of the Port Authority. It was finally decided to adopt friction piles for the mooring dolphin and point bearing piles to rock for the breasting island and approach jetty, and to carry the concrete structure of the land connection right down to rock level 33-ft. below water level. This design required 78 piles for the approach jetty, 200 piles for the breasting island and 104 piles for the mooring dolphin, making a total of 382. During construction, however, it was found necessary to drive 219 piles for the breasting island making an actual total of 401. Only a few of the piles are vertical, the majority being raked up to a maximum rake of 1 in 3.5. Most of the piles were raked 1 in 4.

The construction of the jetty was carried out without the benefit of the protection which the breakwater would later afford the harbour, as the construction of this breakwater only commenced in the spring of 1957.

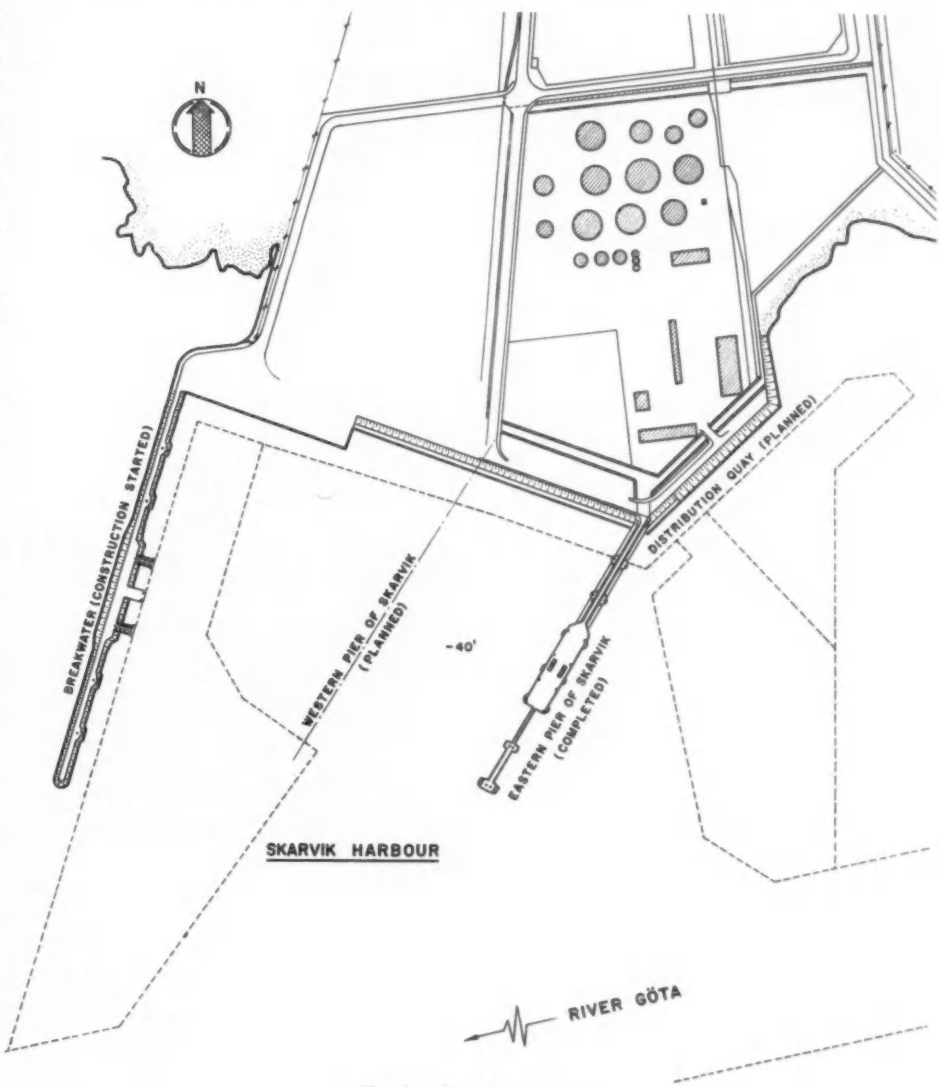


Fig. 1. General Layout.

Skarvik Oil Jetty, Gothenburg — continued

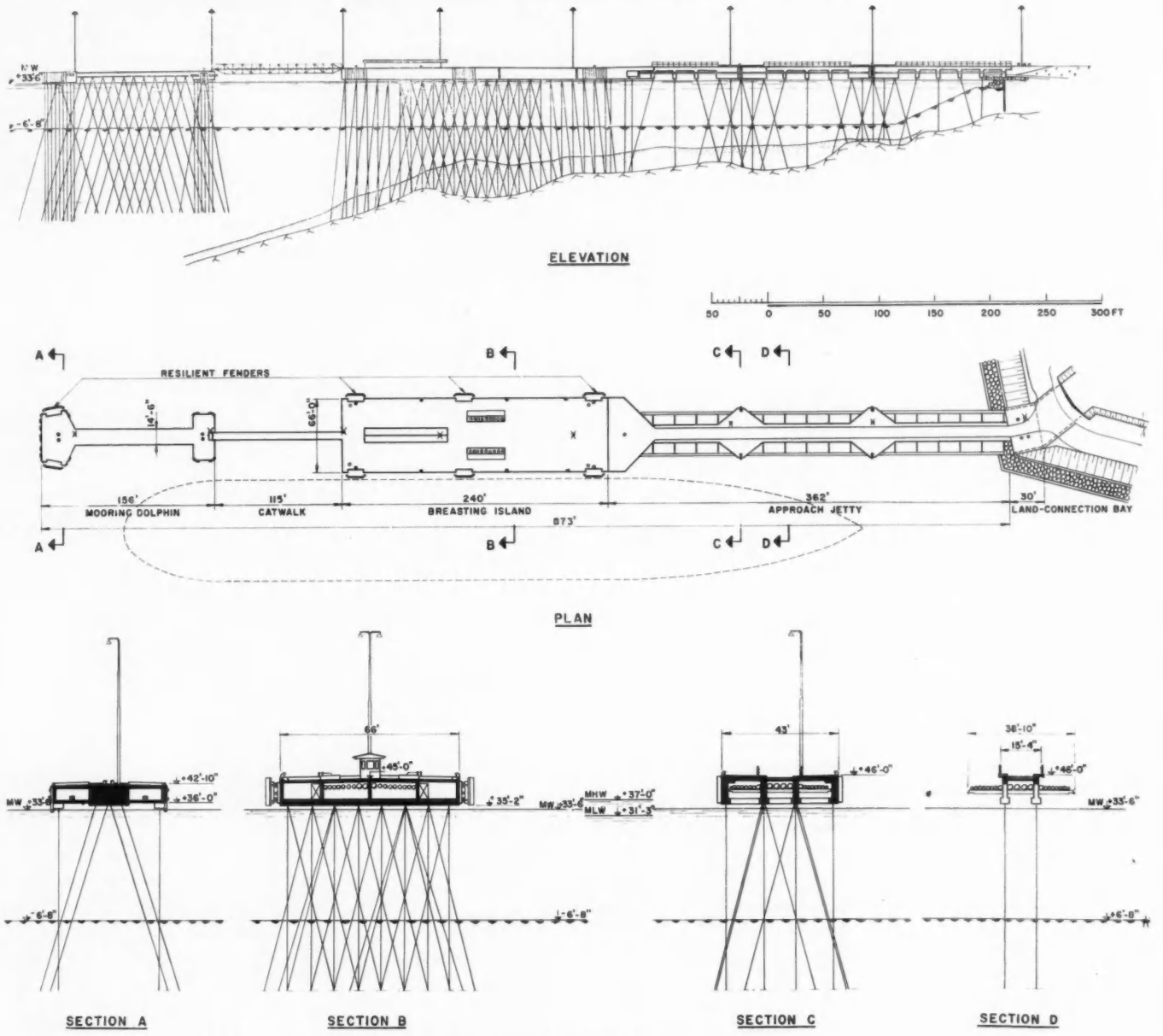


Fig. 2. Plan, Elevation and Cross-sections of Jetty.

Piling Works

Two types of piles were specified, viz. R.C. piles with rock shoes, and R.C. piles joined to timber piles.

The shoed piles were used for driving to rock when the required length was less than 70-ft. The shoe was so designed that after the pile had been driven, it was possible to drill a hole into the rock through a central pipe cast in the pile. The pile was then keyed into the rock by means of a steel dowel (see Fig. 3). This procedure was adopted when the rock bed was inclined to such an extent that it might otherwise endanger the proper positioning of the toe of the pile. The piles were 18-in. square, the longest weighing 10 tons. A total of 34 piles of this type were required for the approach jetty. The remaining 44 piles for the approach jetty and the 219 for the breasting island were of the composite type. The upper part of these piles consisted of a 58-ft. long R.C. pile 18-in. square and weighing 8.5 tons, the lower part being of spruce with a length varying between 16 and 86-ft. The specified minimum diameter at the top of the timber pile was 15-in., which gave the maximum weight of a pile to be approximately 12 tons. Because of the rough head it was found necessary to introduce an extra joint when the length of the timber part of the pile increased beyond 46-ft. Joining of concrete to timber and timber to timber was carried out by means of cylindrical sleeves of 5/16-in.—$\frac{3}{8}$-in. steel plate, 4-ft. 2-in. long which were fixed with $1\frac{1}{4}$-in. diameter through bolts and barbed spikes (see Fig. 4 and detail Fig. 4a). The sleeves were tarred inside and outside to minimise corrosion, and it was specified that no joint should lie less than 8-ft. below the river bed. The toes of these piles were provided with shoes of 3/16-in. steel plate.

The 104 piles for the mooring dolphin were similar to the composite piles described above, but as they were all friction piles, they were all equal in length, consisting of a 58-ft. R.C. upper pile (18-in. square) joined to an 82-ft. long timber pile with a toe diameter of 5—6-in.

In all, 403 piles were cast on the site (two broke during driving). A total of 64 could be cast at a time in eight groups of 8 on

Skarvik Oil Jetty, Gothenburg—continued

a temporary concrete platform lined with paper. The side forms were made of timber treated with oil and were used many times. When the piles were ready they were transported on Decauville cars to the temporary trestleway over a rail track placed along the centre of the platform. The placing of reinforcement in the formwork and the lifting and sidewards moving of the piles were performed by gantry cranes travelling on rails running parallel with the centre track on either side of the platform. The gantries consisted of two I-beams each spanning the width of the platform, supported on timber towers mounted on Decauville trucks, with a 5 ton block running along each of the I-beams. To prevent pile casting interfering with other work on the site, all the concrete for these piles was bought ready mixed from an outside firm. Grade 1 concrete was specified, i.e. high density with a 28 day strength of 5,000 lb./sq. in. with addition of "Darex" to give increased resistance to frost.

The timber piles were joined and prepared for driving on land. The concrete piles were transported to the pile driver on a barge (Fig. 5) and the timber piles were floated out. The piles were driven from a 56-ft. Christiani & Nielsen Pile Frame mounted on a 46-ft. wide undercarriage running on rails supported on two rows of stagings. Each of these consisted of two rows of 82-ft. long timber piles with a minimum diameter of 5-in. These piles were driven approximately 33-ft. into the clay. The stagings were braced to resist wave action, etc., and to help distribute the weight of the pile driver. The fact that the staging settled up to 1-ft. in places shows how poor the sub-soil was.

Driving commenced at the mooring dolphin as these piles were expected to be the simplest to drive and would, therefore, provide useful training for the driving gang. This was indeed found to be the case, and the pile driving for the other parts did prove to be somewhat difficult.

Many soundings were taken to the rock in order to decide upon the necessary lengths of pile. As the levels of rocks at two soundings 8-ft. apart could differ by several feet, and as the soundings were taken vertically, it was very difficult to decide on the correct lengths of the piles required when most of them were to be raked 1 in 4. It must, further be remembered that any joint had to be at least 8-ft. below river bed. It was therefore a great relief when the assumed pile lengths at times were found to be correct. However, quite often the length was not correct and, as adjustment at times proved too complicated, a new pile would have to be driven.

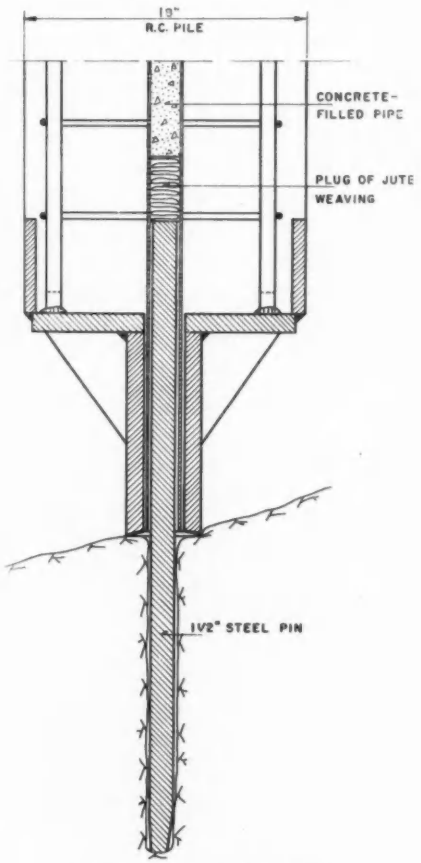


Fig. 3. Detail of Pile Shoe.

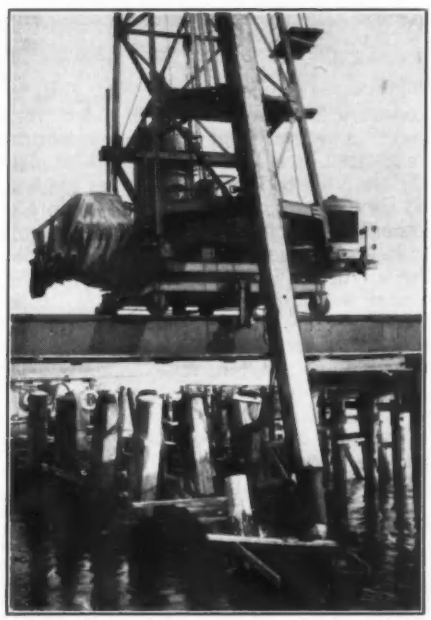


Fig. 4. Jointing of concrete and wooden pile.

The piles were designed for a safe-load of 50 tons, and the actual safe-load was taken from Hiley's Formula. At times the driving took quite an unexpected course, as the point resistance through the sand and gravel layer first increased considerably and later decreased, until rock was reached. For other piles, the resistance increased uniformly as would be expected. The driving time varied from 20 minutes to 5 hours. Two piles broke during driving and in one case the hammer had to be retrieved from the bottom of the river.

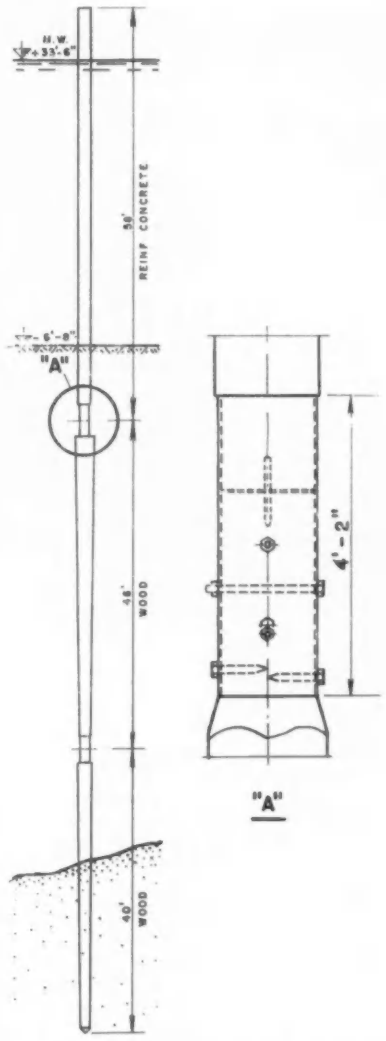


Fig. 4a. Detail of cylindrical sleeve.

The pile driver proved to be easy and fast to handle. The unusually hard driving, however, caused a relatively large amount of wear and tear. The pile driver was fitted for use with steam power, but due to the inconvenience of keeping it supplied with coal, the low winter temperature, etc., the plant was converted to use compressed air as a more suitable means of power. The air was supplied by two diesel compressors with a capacity of 535 ft.^{3}/min. at a pressure of 100 lbs./sq. in. The driving speed was at the rate of 30 blows per minute with a drop of approximately 3-ft. of a 6T hammer and the winch handled the heavy piles with ease. The conversion from steam to air also had the advantage that interruptions caused by stoking were avoided during driving. The pile driving crew exploited the possibilities of the pile driver to a remarkable extent. The number of piles driven per week varied considerably, the maximum being 21 piles but as an average approximately 9 piles.

Skarvik Oil Jetty, Gothenburg — *continued*

Fig. 5. Loading of concrete pile.

An unusual detail of the piling work was the joining of concrete to timber. It was found necessary to transport the concrete and timber piles separately to the pile driver as the composite piles were too long. Depending upon the length of the timber piles, the joining was made in one of two ways. Timber piles, which were long enough, were driven into the clay a sufficient depth to prevent floating of the pile, while the top of the pile was a few feet above the water. The concrete pile could then be joined to the timber pile by pressing the sleeve of the concrete pile over the prepared end of the timber pile. As the resistance of the clay was small, it was found necessary during this operation to suspend the timber pile from the pile frame. The tarred sleeve was heated to reduce friction between the sleeve and the timber.

The procedure for the shorter timber piles was different as they could not initially be driven into the river bed. A 50-ft. long pipe "cage" large enough to hold the pile was lowered on to the river bed. The timber pile was lowered into this cage and the concrete pile suspended from the pile frame. It was then possible to draw the timber pile into the sleeve of the concrete pile by lifting the cage with the piling winch. Finally, the cage was opened and removed, and driving could be commenced.

Every joint was reinforced by two 1¼-in. dia. through bolts and four 1¼-in. barbed spikes. One of the sleeve holes for the through bolts and all sleeve holes for the spikes were drilled in advance thereby enabling the joining to be made in a quarter of an hour.

The piles were temporarily braced before removing the pile frame leader as the unsupported raked piles were unstable. The piles were later provided with a 5-ft. long fender at water level for ice protection. It consisted of a 32-in. diameter steel plate cylinder filled with concrete and is the normal form of protection used at the port of Gothenburg. This fender was constructed by lowering the steel cylinder, provided with a wooden soffit, so far down that the bottom was just above water level. Concrete was then filled into the cylinder and vibrated, while the cylinder was lowered into its final position. The concrete level was always kept above water level during the sinking, and when this was completed, the cylinder was fixed to the pile, until the concrete had hardened.

The temporary staging for the pile frame was left in after the driving was completed. One side of it was used for the transport of materials and for supporting pipes and cables and, in addition, it served as temporary bracing for the piles as mentioned above and also supported the shuttering for the deck. The staging was finally removed by a floating crane.

Concrete Works

The shuttering for the deck was supported on the permanent concrete piles and the temporary staging. The deck shuttering for the mooring dolphin consisted of prefabricated R.C. beams laid on top of the R.C. piles; the R.C. beams supporting temporarily placed steel joists from which the formwork was suspended. The R.C. beams were cast into the final structure making the whole structure monolithic and the steel joists were removed. The solid centre section was cast in two layers with a horizontal construction joint; the first layer supporting the second.

A similar method was adopted for casting the deck slab of the breasting island, the bottom slab being cast in two horizontal layers in order to reduce the load on the shuttering. The formwork was supported on wooden collars (barnacles) fixed around the ice protection. Thus, during the first part of the casting, the weight of the concrete was transferred to the piles by friction between the barnacles and the ice fender. The horizontal forces arising from the raking of the piles were taken by diagonal bracing between the piles. This system worked satisfactorily and no settlement of the formwork was noticed. Some difficulties were experienced due to the bottom formwork being placed so near the water level that even small waves and high water made casting difficult and involved a risk of having the concrete washed out. Fixing of the barnacles was an easy matter, even when at mean water level these were partly under water. The wave action was somewhat reduced by placing 50 ton barges on the windward side of the job. When the bottom slab was cast, it was no problem to finish the remainder of the breasting island.

The plinths of the approach trestle were constructed in the same manner, i.e. the formwork was built up on beams and barnacles resting on the ice fenders. Steel joists were later laid out on the plinths and the formwork suspended from these.

In spite of heavy strengthening and bracing of the formwork for the bottom slab and the frames, damage by wind and waves to the formwork still occurred, but this damage was normally only of a local nature and was easily repaired.

The concrete construction of the pier connection was carried down to rock level by a mass concrete cylinder with a diameter of 23-ft. The rock level here is approximately 33-ft. below mean water level. The monolith was constructed in underwater concrete placed by the tremie method inside steel sheet piling.

The total amount of reinforcing steel used was 200 tons for the superstructure and 150 tons for the piles. All reinforcement was ordered ready bent from the supplier.

Fig. 6. Silo receiving concrete from the distribution pipe.

Skarvik Oil Jetty, Gothenburg—continued

The specified concrete was of high density with a 28 days strength of 4,300 lbs./sq. in. The concrete was produced by a modern weigh batching plant provided with silos for sand, stone and cement. The mixer was a 25 cu. ft. drum mixer and discharge was carried out by reversing the direction of rotation. The batching plant was placed on land near the jetty connection. Transport of the concrete was by means of a pneumatic placer of German make. The concrete was discharged directly from the mixer into an 18 cu. ft. receiving hopper from which it was forced through a 6-in. pipe to the concrete silo (Fig. 6). Before entering the silo the concrete passed through a receiving box mounted on top of the silo which allowed the pressure to reduce to atmospheric. Final placing of the concrete was done by wheelbarrow. The maximum distance of transport by pneumatic means was 1,000-ft. and within this distance the plant functioned very well when certain basic principles were observed. For example, stones must not be larger than 2-in. and should be of rounded shape, and the cement content must not fall below 430 lbs./cu. yd. It was, of course, necessary to keep the consistency of the concrete uniform and this was done by a trained mixer operator. The receiving box would vibrate violently when it was not well lashed down to the concrete silo. The wear on the pipe-line was less than expected, but a few of the pipe bends and, in particular, the receiving box, had to be replaced during the contract.

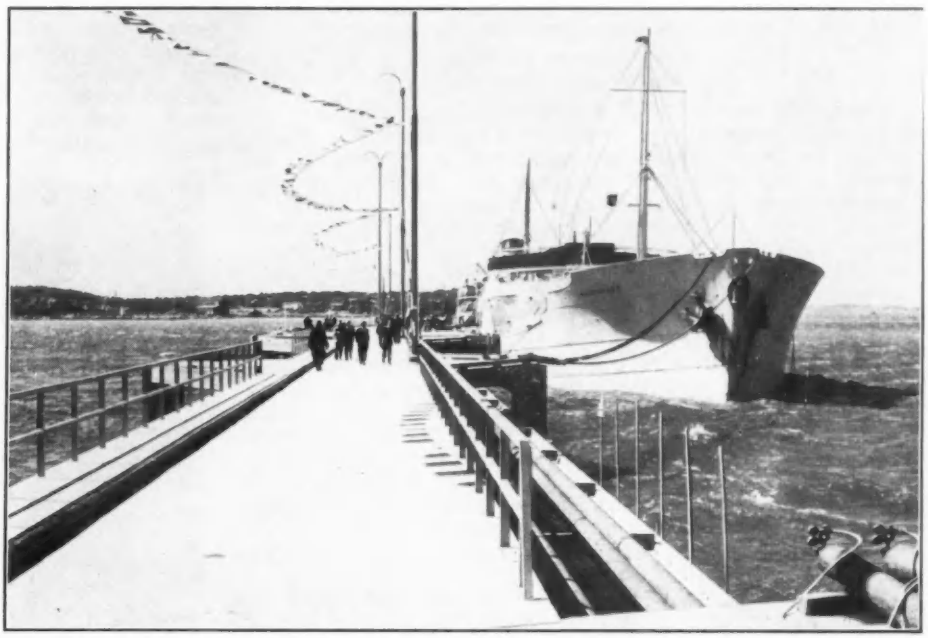


Fig. 7. First tanker mooring alongside new jetty.

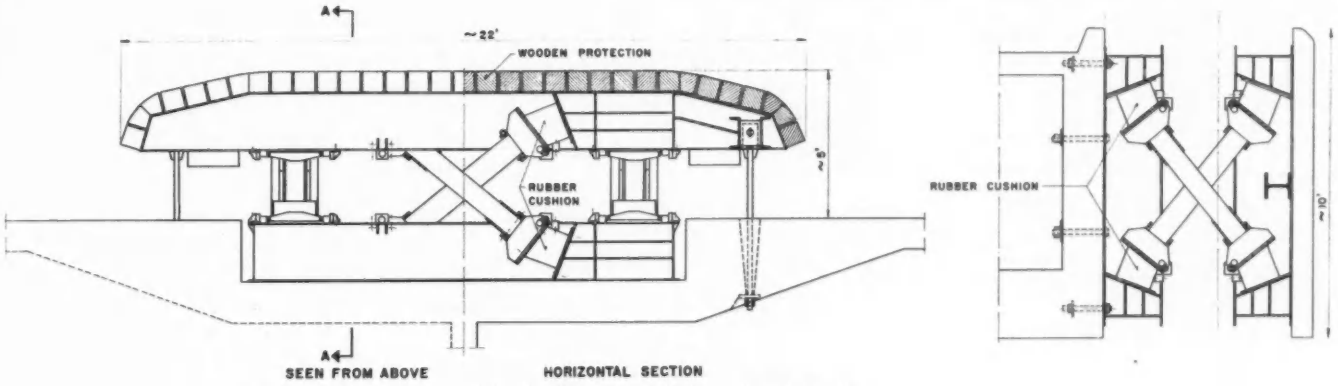


Fig. 8. Details of Resilient Fender unit.

The compressor plant delivering air from the pneumatic transport consisted of two electrically driven compressors (of which one was a standby) and a 210 cu. ft. air receiver. The air consumption was normally 210—250 cu. ft. per minute.

The total concrete quantity in the superstructure, all of which was transported by the pneumatic plant, was 4,400 cu. yds. The normal concrete production was 315 cu. yds. per week, which is approximately 50 cu. yds. per 8 hour shift.

The concrete batching and mixing plant was run by two workmen who were in charge of receiving the materials, batching, mixing and pneumatic handling. Placing was carried out by a gang of 5—8 men.

The experience with the pneumatic plant was satisfactory. The manufacturer claims a capacity of 40 cu. yds. of concrete per hour horizontally or vertically by a transport speed of 5—7-ft. per second. For shorter distances (35—70-ft.), it was found that the quoted capacity could be reached. On the site at Skarvik the greatest delivery distance was 1,000-ft. and the time of transporting was between 3 and 4 minutes. The corresponding capacity was 9—10 cu. yds. per hour.

To control the supply of concrete, it was found necessary to install loud speakers and portable microphones at the batching plant and at the end of the discharge line.

The work executed by Christiani & Nielsen was, in the main, completed in April, 1957, and the first tanker berthed at the jetty on July 2nd (Fig. 7). In the meantime, the jetty had been equipped with four resilient fenders on each side, i.e. two on the outermost point of the mooring dolphin and six along the breasting island. These fenders were constructed and built by The Port of Gothenburg and are of a completely new design (Fig. 8). Each fender has been designed to absorb kinetic energy of approximately 160 f.t. with a final thrust of 215 tons. The travel perpendicular to the jetty is 20-in. through the compression of 16 rubber cushions. These cushions are placed between the ends of four inner crosses of steel beams, 2 horizontal and 2 vertical, and two vertical plates. The outer plate is faced with timber and bears against the ship and the inner is fixed to the jetty wall. By initial compression of the cushions using bolts through the plates, a fender can be made into an easily transportable unit. The weight of such a simple unit is 16 tons and the cost approximately £3,000. A mobile crane could easily and quickly replace a fender unit if it was damaged.

Refrigerated Warehouse at Rotterdam

New Cold Storage Facilities for Hides

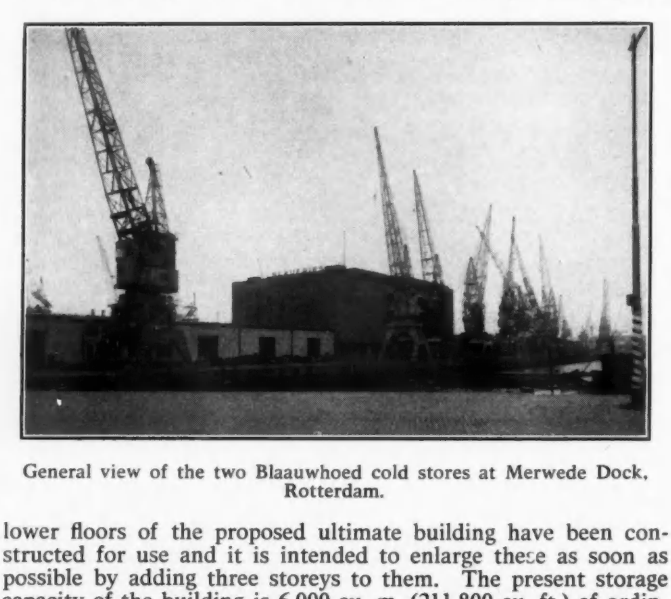
By J. GRINDROD

Claimed to be the first European cold storage warehouse for hides and intended to play an important part in the new futures market for hides which was established at Amsterdam last March, a new refrigerated warehouse has recently been constructed on the Merwede Dock, Rotterdam, by N. V. Europees Huiden Koelhuis (European Refrigerated Hide Storage), a subsidiary of Blaauwhoed N.V., of Amsterdam and Rotterdam. Here, it will be possible for hides to be stored over long periods without loss of quality and in order to avoid forced sales on account of deterioration or when prevailing market conditions are unfavourable.

Blaauwhoed N.V. claim to be the oldest established cold store owners in Holland, having been in business at Amsterdam since 1905 and at Rotterdam since 1914. Their large post-war cold store, said to be the most modern in Rotterdam was completed on the Merwede Dock in 1951 for the storage of such commodities as fruit, meat, butter, eggs, milk, etc., and has since proved to be an up-to-date establishment for handling and preserving many kinds of goods, both by quick freeze and normal refrigeration methods. The new hides refrigerated warehouse has been constructed next to this building.

During recent years, however, it has been found that shipments of hides were being concentrated more and more at the Port of Rotterdam, the movement being in a west-east direction from suppliers in North and South America, and to a less extent in Australia, New Zealand and South Africa, to buyers established throughout the continent of Europe.

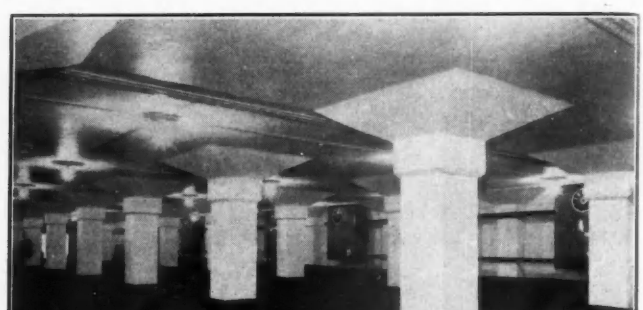
Those hides not destined for immediate transit are usually held in storage, such normal storage over a period of months being possible by additionally salting the hides. To avoid forced sales on account of deterioration when prevailing market conditions are unfavourable, however, the trade requires storage facilities for much longer periods and it is in order to meet these requirements that the present store has been built. At present only the



General view of the two Blaauwhoed cold stores at Merwede Dock, Rotterdam.

lower floors of the proposed ultimate building have been constructed for use and it is intended to enlarge these as soon as possible by adding three storeys to them. The present storage capacity of the building is 6,000 cu. m. (211,800 cu. ft.) of ordinary cold storage space and 5,500 cu. m. (194,200 cu. ft.) of cellar cold-storage space. As a result of the enlargement of the building the total storage space for hides will be considerably increased.

In the refrigerated area, modern equipment has been provided for assuring the correct storage conditions for long periods, the hides being first frozen and then stored in air, conditioned to the right temperature and humidity. The hides are either piled or put on stack. Hides in bundles are piled, i.e. the bundles are placed on laths, the piles being kept separate with some distance between them so that the cold air can circulate under and between the piles. When stacked, the hides are unfolded so that they can be laid down in a flat condition. When they are stacked in this way salt is added between the layers for good preservation. Stacking is, however, only resorted to if required by the principals for whom storage is being provided.



The basement of the hides refrigerated store at Rotterdam, showing some of the 24 dry unit coolers mounted on the walls.

In order to bring and keep the refrigerated storage space and the hides stored therein to the right temperature, 24 dry unit coolers are mounted alongside the walls, each being provided with a ventilator or fan. The cooling capacity of each of these units amounts to about 6,900 kcal./hr.* giving a total cooling capacity of about 165,000 kcal./hr.** which is equal to about 50,000 tons of refrigeration. Each ventilator has a capacity of 6,600 cu. m./hr., giving a total ventilation capacity of 158,000 cu. m./hr., yielding approximately a thirty-fold circulation. The capacity of the coolers, ventilators and the back-pressure valve built in to the ammonia system enables the company to regulate the relative humidity as required.

Since the equipment in the storage area does not include any valves or similar apparatus the chances of ammonia leakage are practically nil.

In order to keep the temperature as even as possible, the gauge of liquid ammonia in the separators is regulated electronically, while room thermostats command the magnetic main stop valves. Further regulation, as well as control can be carried out from the control panel in the engine room, where the temperature can also be read and recorded.

Together with its older sister building, the new refrigerated hide storage is located on a deep water quay with double railway connections, both on the water and land side of the warehouse. The quay is equipped with ten modern electric cranes with a reach of 36 m., while fork-lift and platform trucks can convey the hides quickly to or from storage. Within the building a large goods lift facilitates quick transport from one floor to another.

With this beginning of a futures market for hides in Holland, the new Rotterdam storage facilities will assume even greater importance in the continental hides and leather trade. Up to the present such a market has existed only in the United States.

*=about 27,600 B.T.U./hr. **=about 662,000 B.T.U./hr.

The Use of Radar in Dyke Construction

A Radar survey chain is to be used in the re-construction of the Dutch dykes damaged in the flood disaster of 1953. The equipment which is at present under construction will come into operation next September. The foundations for the new dykes will be composed of large quantities of boulders laid on "mats" on the sea bed. The radar chain will enable the boulders to be placed in position with great accuracy regardless of weather conditions. Radar will also be used during the operation to co-ordinate and control the small craft assisting in the construction works.

Modern Dry Docks

VII Culvert Sluices and Valves

By HENRY GARDNER, J.P., M.I.Mech.E.

REFERENCE has been made, in "Dock Pumping Machinery," to the valves that are associated with pumping plant, and which usually form an integral part of it. Also of major importance in the working of dry docks, is the similar kind of equipment that is installed in the impounding and dewatering culverts.

In most cases, graving dock operations have to be carried out at high speed commensurate with safety, as the capital and working costs of modern ships are very high and, although dry-docking invariably has to be undertaken at fairly regular intervals and has to be budgeted for, all the time a vessel spends in dock it is out of commission, thus incurring a considerable loss of income to its owners. Whilst many factors are involved in achieving economic operation it is in some measure dependent on the rate of filling and emptying the dock.

Flooding is principally carried out by gravity flow through high capacity culverts built into the dock walls at a low level, with their intakes outside the dock entrance and having a number of outlets at strategic points in the walls. Whereas, dewatering is normally by pumping, the water being led to the pump sump chamber and discharged from the pumps through subsidiary channels. Frequently, to minimise constructional outlay and give flexibility in working, the culverts are made to form a virtually continuous system, wherein some sections are dual purpose. Irrespective of how the waterways are laid out, however, it will be readily understood that their use is dependent upon the efficient and reliable action of the means that, of necessity, have to be applied at various positions throughout the arrangement, for isolation and other duties.

The equipment used for these purposes takes the form of a sluice or a valve, and it is a general rule that whichever is used, it has to be designed to withstand pressure in either direction. In each category there are a variety of different types, and the choice of one for a particular service depends on the capacity and shape of the waterway, the hydraulic conditions in it, the duty to be performed, the location in the system, the size required, and the method of operation.

Culverts

Culverts for impounding purposes are usually large enough to fill a dock in about one hour. Initially the rate of flow in them may be as high as 50-ft./sec., and all transitions, or changes of direction, must be very gradual. For dewatering, they have to be capable of conveying water from the dock to the pump sump chamber without danger of cavitation, and experience suggests that the average velocity into the sump should not exceeed 10-ft./sec. The time allowed for emptying a dock is in the region of 2½ to 3 hours.

Generally, culverts are lined with good class concrete, which is satisfactory provided due attention is paid to design detail. For example, the intricate shuttering involved at throats and junctions may advantageously be avoided by the use of special cast iron linings; this applies particularly to those for impounding.

Sluices

In the past, direct lift sluices, or gates, were widely employed, as they were well suited for installation in docks of the size and depth then in use. Today, however, their application is somewhat limited, although some authorities, for example the Mersey Dock and Harbour Board, still use them extensively.

Design and Construction of Sluices

The shape of a sluice can be ovoid, circular, square or rectangular, the latter being the most common. In Britain, the gate, or paddle, is normally almost wholly of greenheart timber, but on the continent, cast-iron, steel or a light steel frame planked on both sides with greenheart are often preferred.

A greenheart paddle is built up of solid beams, planed all over, keyed together by oak tongues red-leaded into grooves in the logs and secured with heavily galvanised bolts, the heads and nuts being recessed in the wood and the recesses filled with red lead

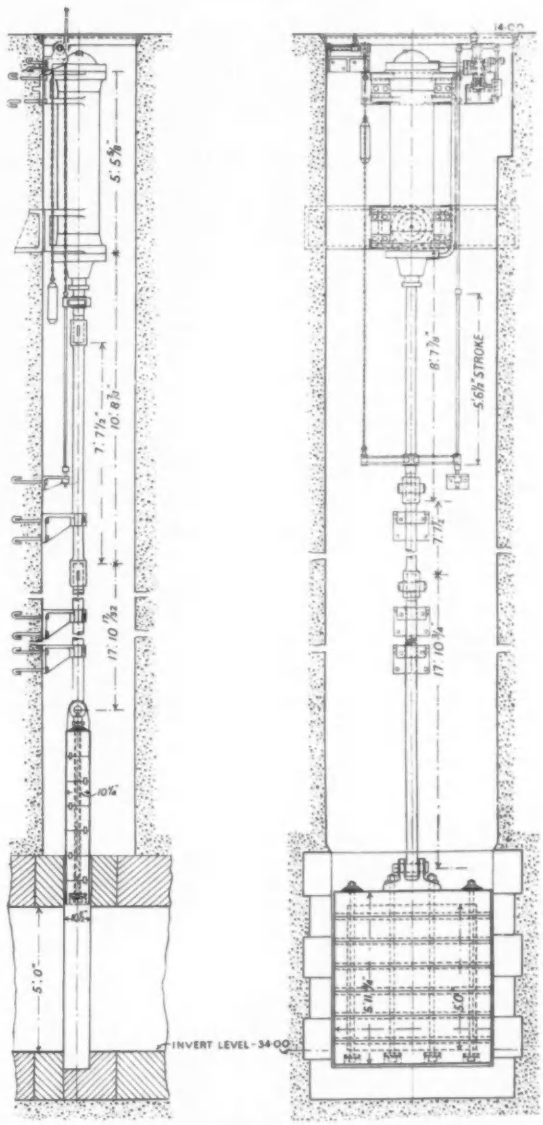


Fig. 1. General arrangement of hydraulically operated greenheart sluice.

and plugged with greenheart plugs. The ends of the beams are carefully caulked and then painted. The working faces of the assembly bear directly, across the grain without any facing material, against jambs of polished granite

Cast iron sluices are heavily constructed, with strong ribbing, and work in grooves formed in cast-iron frames embedded in the masonry. At the sides of the gates, on both the front and rear

Modern Dry Docks—continued

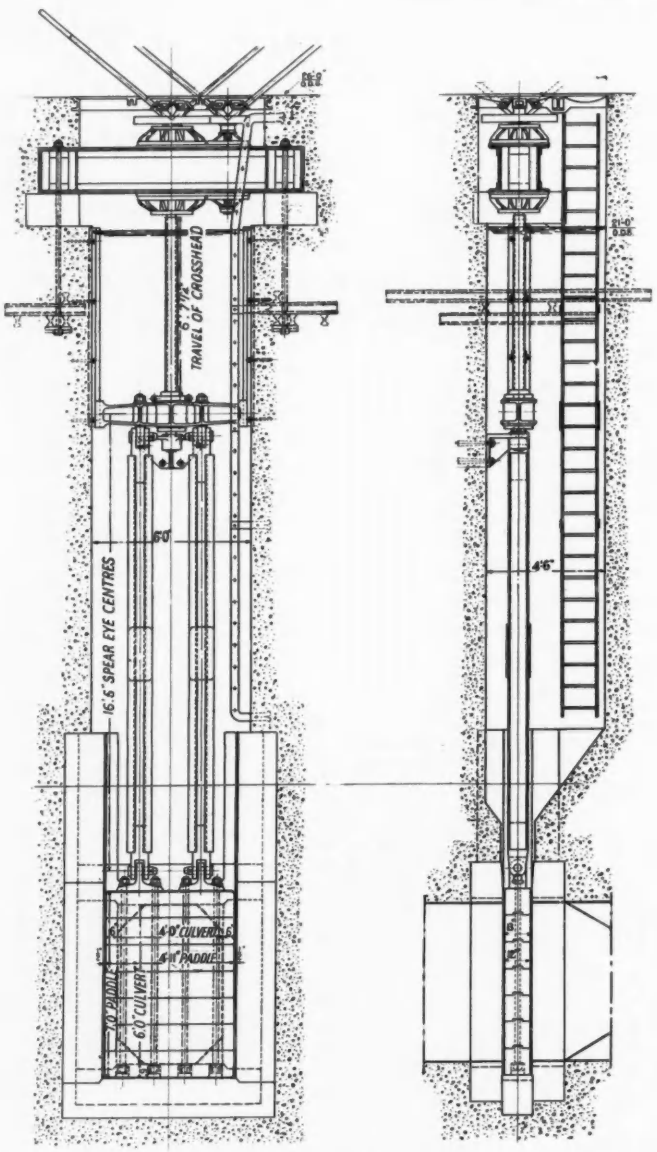


Fig. 2. General arrangement of manually operated greenheart sluice.

edges, are fitted zinc-free bronze bearing strips that slide over similar strips in the grooves.

Occasionally, various designs of balanced sluices have been adopted, with a view to reducing the mechanical effort required to actuate them.

In one form, two paddles are provided at different levels and suspended from a transverse rocking arm, the weight of one, with its rods and other fittings, balancing that of the other. With this device, either two separate culverts have to be provided, or a single culvert is led into two branches at the point where the gates are fixed; the civil work involved by this expedient, though, is an obvious disadvantage.

Another style used is, in effect, a double-beat valve. It comprises two cast-iron circular discs united by steel columns. The discs have gunmetal faces that mate with similar faces in a cylindrical cast-iron casing. In action, the water pressure on the upper surface of the top disc balances that on the underside of the lower one. Sluices of this kind, having discs of 4-ft. 5-in. dia. are installed in 6-ft. 6-in. dia. culverts in a dock at Le Havre.

A further pattern had a butterfly type of gate with its shaft bisecting the channel vertically. Silting, however, especially around the foot-step bearing, soon showed that this design was not satisfactory.

Operation of Sluices

In most cases, sluices are worked by hydraulic power. Large sizes have the piston rod of the actuating cylinder coupled to a cast-iron crosshead, which is connected to the gate by two rods, or spears. Smaller sizes have the piston rod directly attached to the gate.

Sometimes auxiliary hand gearing is fitted in the form of a rack and pinion. The rack is mounted vertically on the crosshead, or gate, and the pinion on a horizontal shaft also carrying a large worm wheel that is rotated through a vertical shaft, at the upper end of which is a capstan head. A mechanism is provided to engage and disengage the gearing as required.

When conditions permit, operation is often entirely manual.

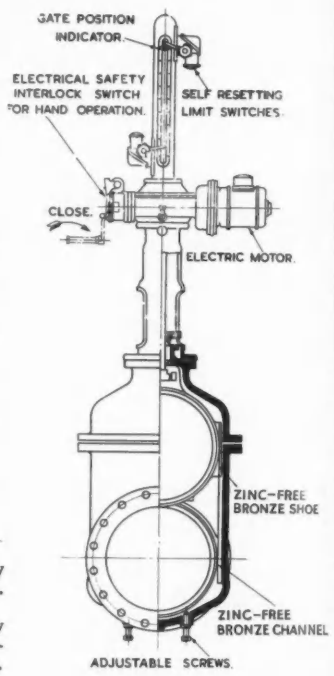
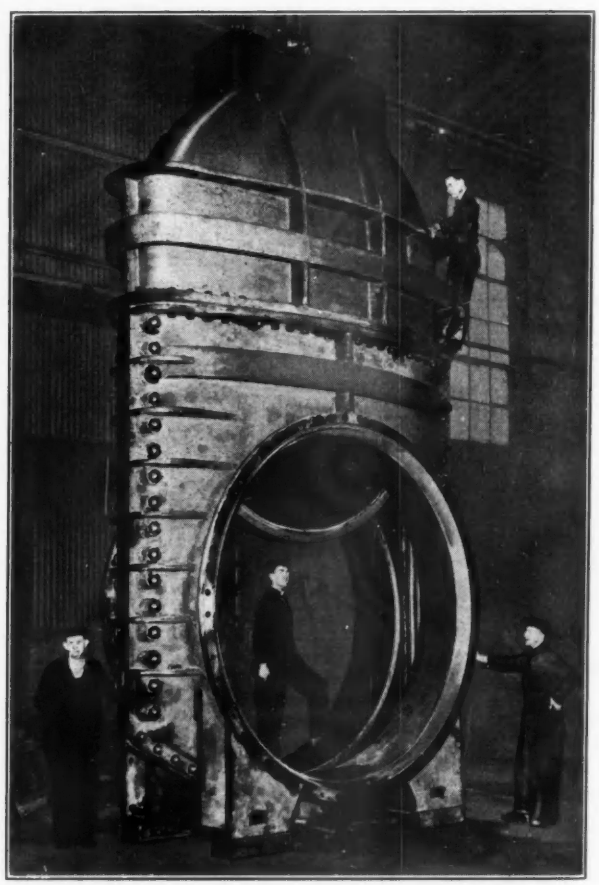


Fig. 3 (right). Typical electrically driven outside-screw sluice valve.

Fig. 4 (below). 9-ft. dia. electrically operated culvert sluice valve, Captain Cook Graving Dock, Sydney.



Modern Dry Docks—continued

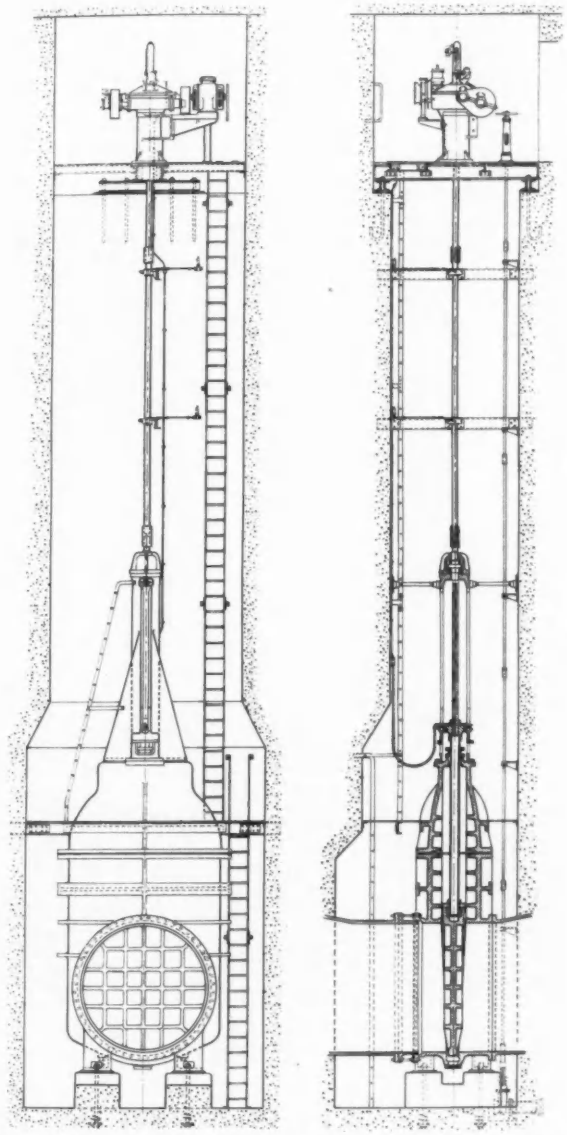


Fig. 5. General arrangement of 7-ft. dia. electrically operated sluice valve, The Sturrock Graving Dock, Cape Town.

In this instance, the crosshead, or door, carries a nut to take a screwed spindle, rotated through a headstock or capstan.

Fig. 1 illustrates a typical greenheart sluice arranged for hydraulic working with the piston rod directly connected to the paddle. This unit, which has a 4-ft. 6-in. wide by 5-ft. deep paddle, is installed in a 5-ft. square dewatering channel at Elderslie Dock, Glasgow. Fig. 2 shows the general arrangement of a hand-operated 4-ft. 11-in. wide by 7-ft. deep greenheart sluice with twin spears and crosshead, that is fitted in a 4-ft. wide by 6-ft. deep entrance culvert in the Mersey dock works.

In view of the purpose of a dry dock, it is a prime essential that the land surrounding it be kept free of obstructions so far as is possible. Consequently, the operating mechanism of culvert sluices and valves is invariably located below ground level, with the occasional exception of permitting an indicator to rise through a removable hatch in order to see readily the position of a gate, unless, of course, it can be accommodated in a building, such as the main pump house.

All the sluices previously mentioned operate in wet wells, and their actuating equipment is mainly in a damp, and rust promoting atmosphere. To obviate this, therefore, there is an increasing

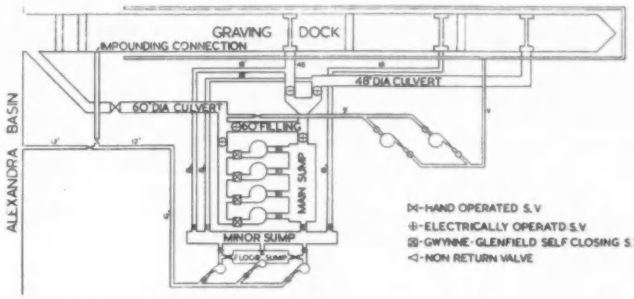


Fig. 6. Diagrammatic arrangement of culverts, valves and pumps of new dock at Dublin.

tendency in modern practice not to use sluices but to employ valves. This has the distinct advantages that the valve body can become an integral part of the culvert and the well is free of water, allowing its actuating gear to be located in a dry and accessible position.

Design and Construction of Valves

Valves, like sluices, can have a variety of different shaped waterways, but in their case by far the commonest is circular. They are generally wedge-faced outside-screw, or extended spindle, sluice valves, of orthodox design. The outside-screw pattern is generally preferred because of its accessibility for maintenance (Fig. 3).

Construction is essentially of cast-iron, which withstands the corrosive action of sea water better than cast or mild steel, with zinc-free bronze faces that are secured in position by countersunk screws. Channels, on each side in the bodies, and projections, or shoes, on the sides of the doors, faced with zinc-free bronze, take the bearing load when a valve is being opened or closed. Adjustable screw stops are fitted under the valves and are set, during erection, to contact prepared faces on the doors to prevent them becoming wedged in the closed position.

Important installations incorporating valves of this kind include the Captain Cook Graving Dock in Sydney and the Sturrock Graving Dock, in Cape Town. At Sydney there are four of 9-ft. dia. (Fig. 4) and nine of 6-ft. dia., and at Cape Town eight of 7-ft. dia. (Fig. 5) and three of 4-ft. 6-in. dia. All are similar in design and follow normal practice in construction, with heavy reinforcing ribbing. Because of their size, the 9-ft. dia. valves in the Sydney Dock, have their bodies in two parts, bolted together; it is of interest that these units are among the largest sluice valves ever produced, each having a total weight of some 54 tons.

In the new dock at Dublin, which was brought into commission last year by the Dublin Port and Docks Board, the culverts are controlled entirely by sluice valves.

This dock has been designed, like some others, to be divided into two separate compartments, to allow of adaptability and economic working. As a result, a somewhat complicated system of cast-iron pipework, forming the culverts, and valves was necessary for impounding and dewatering the dock as a whole, and each portion independently of the other. The layout is shown diagrammatically in Fig. 6. A main filling and emptying culvert, 60-in. dia. and having a similar sized cut-off valve, runs from Alexandra basin to the pump-house valve pit. Here it branches into two sections, each with a 60-in. dia. isolating valve, one forming the discharge manifold of the main dewatering pumps, and the other the main gravity filling line. The latter connects with another 60-in. dia. length leading in one direction to the main sump at the inlet of which is a fourth 60-in. dia. valve, and the other way to two 48-in. dia. branches, with the same size of valve in each, that impound different sections of the dock, or drain them off to the main sump. These two culverts are connected by 18-in. dia. pipes to a minor sump, that also has a direct connection to the dock, and a 30-in. dia. one to the main sump; the lines having 18-in. and 30-in. isolating valves respectively. A 12-in. dia. branch provides for discharge from the minor and floor sumps, either into the harbour or the dock, and has valves of this size at

Modern Dry Docks—continued

the cross-over connection. Fig. 7 shows the 60-in. dia. sluice valves at the bifurcation of the main inlet/outlet culvert.

Although the conventional style of sluice valve is rarely departed from, an example of a modified design is in use in the King George V Graving Dock at Southampton. There, the valves, eleven of 10-ft. dia. and six of 6-ft. 6-in., are not fitted with domes, the open tops of the casings communicating freely with the valve wells. The top part only of the wells, where the operating gear is situated, is kept dry by water-tight decks, through which the actuating screws pass, by way of packed glands. Air valves are provided to release, or admit, air when the water level is rising, or falling, in the wells.

Sluice valves having other than circular waterways are seldom employed, and then only because of some special requirements such as a dock having one or more shallow culverts that only need a gate of low lift.

A style of valve that has gained in favour in recent years, because of its simple yet effective design, is the cylinder, or equilibrium, valve. Such units have been adopted for filling purposes in a number of docks in Britain, particularly on the North East Coast, and in Holland, where they are also used in lieu of sluice valves where adjacent docks drain into the same sump.

A typical valve of this kind is installed in Smith's No. 8 Dry Dock at North Shields. Here, the valve is located in a wet well having an uncontrolled entrance, with screen and provision for sectioning-off by stop-logs, from outside the dock, and a 5-ft. dia. culvert connection to the main sump under the pumphouse, which communicates directly with the dock. It consists of a 6-ft. dia. counterbalanced mild-steel cylinder, set vertically over the conduit inlet. Fitted to the base, is a rubber seal that seats on a machined edge of a galvanised angle ring attached to a cast-iron pipe, tapering from 6-ft. to 5-ft., leading into the culvert. The top of the angle ring is positioned so that impounding can take place at any state of the tide. Raising of the cylinder is by a capstan screw at coping level; the maximum lift being 18-in.

Operation of Valves

Operation of culvert valves can be by hand, hydraulic or electric power. The two former methods have proved themselves over the years to be capable of long and reliable service, but today the latter is being more widely applied; the valves at Sydney and Cape Town, and three of the 60, and the 48, 30 and 18-in. dia. ones in the new dock at Dublin are all electrically driven, as are the modified units at Southampton. A contributing factor to this change is undoubtedly the more general use of valves, particularly sluice valves, thereby making available dry chambers for the housing of the actuating mechanisms. In addition, with the provision of suitable accommodation, electrical operation has significant advantages, such as the compactness of the equipment and its adaptability to centralised remote control and position indication.

Electrical working is usually by a totally-enclosed, drip-proof, reversible, squirrel cage motor, designed to develop a high starting torque and for switching directly on to the lines in one step. For valves installed in humid atmospheres it is advisable to incorporate a heater element, or take other precautions, to prevent condensation within the machine. Motor power is transmitted to the valve spindle, of mild-steel or forged-bronze, through machine cut worm and spur reduction gearing, in a casing forming an oil bath. The rate of lifting or lowering is normally within the limits of 12 to 15-in./min.

Starters consist essentially of reversing contactor panels, and up-to-date ones can be of an electro-automatic torque limiting nature. This arrangement, which is usually applied to motors of 3 b.h.p. and above that are positively geared to the valve spindles, is one of considerable worth, as it ensures, with certainty, that every part of the valve and its gear are safeguarded against overstrain. In the opening direction, power to twice full load torque is applied at starting to unseat the valve door, and then, after the motor attains full speed, is limted to full torque only throughout the travel. On closing, power is limited to full torque at all times. In either direction, the motor is cut out instantaneously on overload arising from any cause whatsoever, for instance, the arrestment of the door by an obstruction in the waterway, the over-run of the door at the extremities of its travel due to a faulty limit switch, or the single phasing of the power supply. In the case of the motor itself, "pull-out" torque cannot be applied and, therefore, it can never stall under power.

An alternative, and equally reliable, means of overload protection, can be in the form of a slipping clutch. This device gives, at one setting, the correct torque for the closing operation and

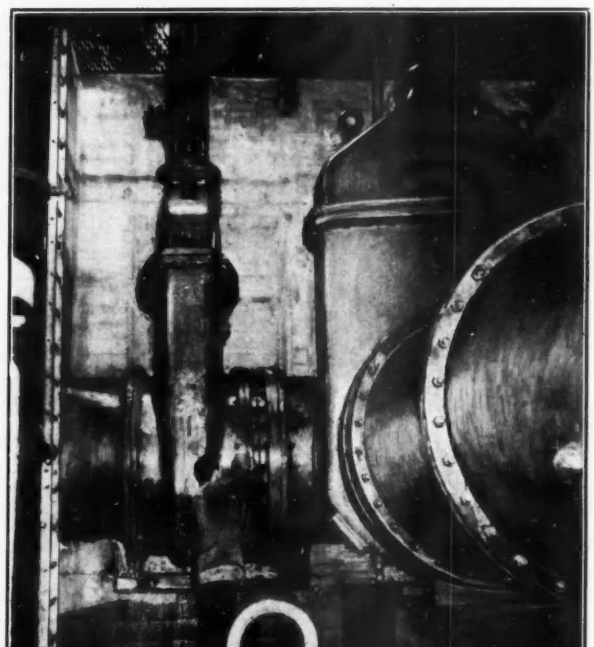


Fig. 7. 60-in. dia. electrically operated sluice valves at bifurcation of main impounding/dewatering culvert in new dock at Dublin.

the necessary extra torque for the opening stroke. In the event of undue resistances to the movement of the gate at any stage of its travel, the clutch begins to slip immediately.

Control can be local and, or alternatively, remote through "open," "stop" and "close" push buttons, with which can be associated electrical gate position indication, by coloured lights or pointers and scales. Where a number of valves are involved, it is up-to-date practice to effect remote working and indication through a form of centralised control desk, as fully described in "Dock Pumping Machinery." (See Fig. 11—April issue.)

All electrically-driven valves have self-resetting limit switches, local mechanical position indicators and emergency hand gear. The latter comprises a crank handle that fits on one end of the worm shaft, which is extended and squared for this purpose, care being taken so that the motor cannot be energised while the handle is in position. This is often accomplished by fitting a hinged door on the end of the casing enclosing the shaft, that embodies a safety interlock switch which breaks the circuit to the motor whenever the cover is not closed.

Whilst the modern tendency is towards the increasing use of electricity in entirely new installations, it is often preferable when making extensions or building additional docks adjacent to present ones, to utilise the power that is already available, which is frequently hydraulic.

This is the case at Falmouth, where one of the four docks there is under reconstruction to give extra accommodation.

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Shannon Estuary Development

Examination of Tentative Proposals

By DESMOND BRANIGAN
(Council Member The Maritime Institute of Ireland).

Since the publication of an article by Major J. H. de W. Waller in the November, 1956, issue of " The Dock and Harbour Authority," in which he proposed the development of the River Shannon Estuary, a great deal of discussion has taken place as to the practicability of his suggestion. While the author of the contentious article merely proffered suggestions for consideration, especially with relation to the development of the Shannon Estuary as an oil entrepôt, subsequent suggestions covered many other possibilities. Principal amongst these was an idea that large-scale storage for re-export could take its place as well as manufacturing. This latter was especially proposed in order to take advantage of the Free Trade project. The general justification advanced for all these ideas was the advent of the Great Ships and the supposed inability of other European ports to cater for them.

Whether by relation to the Shannon Estuary Free Port project or the European situation generally, the various matters involved are of importance to all of those engaged in shipping in the north western sphere of Europe. In this article an attempt will be made to take stock of the many important items that have been called into question. It will be appreciated that in an article of this nature one cannot do more than make the briefest reference to each aspect, and quote authority for what appears to be the up-to-date position in relation to it.

Future Ship Sizes

Now that it has been established beyond the theory and blueprint stage that Big Ships are more economical to build and operate than small ones, large craft of all types are being ordered with increasing frequency. The nature of competitive commerce, especially in shipping, will dictate further developments as the larger ship gains trading advantages. Although the trend towards higher tonnages is confirmed, the size at which the standard will be set is as yet unknown; the experts are either cautious or sceptical about the extent to which the very big ships will be in demand. The consensus of views is against any significant percentage of shipping being in the 80/100,000 ton class.

The shipping correspondent of " The Times " in a much quoted article (March 26th 1957) which has been interpreted to mean that only the absence of port facilities is arresting the trend towards very large ships, actually said:

> " While the 45/65,000 tonner will probably become part of the staple diet of the shipyards, British builders are unlikely to rush into expensive conversion programmes, to build the 100,000 tonner and over. These vessels will never form more than a small proportion of the world's ship building programme."

Mr. Basil Mavroleon, Chairman and Managing Director, London and Overseas Freighters Ltd., a company having tanker holdings to the value of £10,000,000, is another outstanding authority. Commenting on " The Times " article he said:

> "As regards performance, it must not be forgotten that no one has yet gained practical experience of operating really big tankers—one cannot help noticing the disproportionately increasing number of entries concerning super tankers in Lloyds casualty reports, and one wonders if in practice the ships are really falling short of their theoretical superiority. In my view the time is not yet ripe for individual owners in this country to contemplate building tankers much over 40,000 tons."

There are many others with a similar view but these will suffice to reflect the realities and limitations of the present trend.

Port Problems

The change in ship sizes poses some serious problems for those responsible for providing terminal facilities. The extent to which port authorities adjust the area under their charge to changing needs may well dictate the difference between encouraging or arresting the tendency towards bigger ships. No doubt it was considerations of this nature which inspired Major J. H. de W. Waller's suggestion regarding the possibilities of the Shannon Estuary. This potential port is situated on the west coast of Ireland and has the advantages of a large expanse of very deep water in a relatively sheltered position.

The opinions expressed by some of the supporters of the Shannon Estuary development project regarding the absence of fog in this area, and that tugs would rarely be required due to the area being sheltered, can not be taken too seriously. The high incidence of fog in ports like London and Liverpool did not prevent them from developing, and as long as ships' machinery is designed for propulsion rather than manœuvring, tugs will be required to berth and unberth them. It would be unwise to try and manœuvre a 10,000 ton, let alone a 100,000 ton tanker, alongside a jetty without the use of tugs, especially in the Shannon Estuary where a strong current is experienced.

Major Waller and his supporters believe that the Shannon Estuary could come into its own as a result of the trend towards deeper draft ships. It has been argued that it would be either impossible or prohibitively expensive for present European ports to prepare themselves to cater for these craft. On the face of it this is hard to accept. Considering that it is a cardinal question, there has been no convincing effort at establishing that such difficulties are being experienced. Both the work actually in progress and also that planned in many European ports to deepen certain areas to cater for the greater ships dismisses the idea that they will be unable to do so.

Development and Maintenance Dredging

The suggestion that the Shannon Estuary would be developed because other ports cannot provide the depth of water required by modern vessels cannot be accepted unless much more concrete evidence of depth difficulties elsewhere is provided. It cannot be overlooked that present ports were initially chosen and continue to maintain their trade because of their geographical and physical suitability. Few if any of them could originally cater for even the depth of ships they at present accommodate. This did not prevent them from expanding, nor can it be easily shown that it will do so in the future.

It is true that dredging is an extremely expensive factor in the economics of port operation. Once the **development** dredging necessary to achieving greater depths is completed, the **maintaining** of that depth thereafter will rarely call for a greater number or different type of routine dredging craft than were originally employed. Neither would there be any significant addition to previous maintenance costs. The extra expenditure therefore in which a Port could be involved would be largely initial and would tend to culminate at the conclusion of the dredging required to provide deeper water. Generally speaking the proposition that may face an existing port in the light of shipping developments, is that it would expend certain sums on development dredging in order to maintain its trade and status. It is difficult to see that any port authority would fail to enter into such arrangements, except as a result of their coming up against insurmountable physical difficulties. There has been no report of such a proposition facing any important European port.

Modern Dry Docks—continued

All the new culvert valves are to be hydraulically operated, and the motive units, mounted on the valve domes, will be pressurised from the existing power plant and controlled through remotely positioned balanced hydraulic control valves.

References

1 " The Design, Construction and Maintenance of Docks, Wharves and Piers," by F. M. Du-Platt-Taylor, M.I.C.E., M.I.Mech.E., M.Cons.E. (Eyre and Spottiswoode).

2 " Civil Engineering Reference Book," by E. H. Probst and J. Comrie (Butterworth's Scientific Publications).

3 " Design and Construction of No. 8 Dry Dock at North Shields for Smith's Dock Company," by T. F. Burns, M.I.C.E., M.I.Struct.E., Proc. Inst. C.E. 1955, Vol. 4, Part 2, Engineering Division.

The author thanks Glenfield and Kennedy Limited, for permission to publish much of the material contained in this article.

Shannon Estuary Development—continued

Free Port Facilities

In considering the theses put forward by Major Waller, that ships would be so large as to require the type of facilities that the Shannon can offer, many additional considerations developed. One was that, in the absence of any hinterland market, the only outlet for goods deposited in the Shannon would be on a re-export basis so that a free port area would have to be established. From the outset the suggestions centred around the idea that, as the large ships could not get their cargoes to the destination ports, the goods would have to be deposited and re-distributed from the Estuary. This would necessitate an entrepôt arrangement.

An examination of the re-export market position in Europe has demonstrated that only a very small percentage of goods deposited in existing free ports are re-exported. Therefore the only possible justification there could be for a free port arrangement in the Shannon Estuary, would be the inability of European ports to take the larger ships, and not because there is any ordinary commercial demand for such trade.

Whether for the purposes of examining the potential for an entrepôt because of the development of very large vessels, or any other reason the position regarding the actual scope there is for such trade is well worthy of examination. An exhaustive survey of European free ports was carried out by Dr. Richard S. Thoman, Professor of Geography at the University of Omaha. The results of his research were published in 1956 in a book entitled "Free Ports and Foreign Trade Zones." The only free ports operating in north Europe are those in Germany and Scandinavia. Having examined the functions fulfilled by each group Dr. Thoman came to these conclusions:

German Free Ports: "An important trait of the successful free ports of the German Federal Republic is that their primary warehousing function regarding Foreign Merchandise has been the facilitation of imports to Germany. This means a sharp deviation from their traditionally predominant role of aiding re-exports, a deviation that has not yet been given adequate recognition. For at least a quarter of a century warehouses in the active free ports of Germany and the subsequent German Federal Republic have been predominantly instruments of import to the mother country."

Scandinavian Free Ports: "The re-export commerce whether direct or indirect, appears to be markedly reduced, especially since the last war. The primary purpose of the free port device in Scandinavia like that in the German Federal Republic appears to be increasing the provision of "convenience storage" outside customs' barriers for a few high value, high tariff commodities that are destined to be imported ultimately into the host nation."

Summarising the European situation Dr. Thoman said: "The major function of the free port device of northern Europe is the facilitation of imports into the host nation with which the free port is associated. Lesser functions include the storage of merchandise for re-exports and the accommodation of manufacturing. Of these, the re-export function has been declining in significance both prior to and since the establishment of the Iron Curtain."

European Free Trade

It has further been mooted that the establishment of a Free Trade area in Europe would justify the development of a free port in the Shannon area. This idea is based on the assumption that, if a large free port area were provided, manufacturing for re-export could take place on a scale to justify the scheme being adopted. It was assumed that American or other manufacturers from outside of the free trade group could utilise the free port facility for the purposes of exploiting the tariff-free opportunities provided by a free trade agreement. This idea however does not take into consideration the fact that before goods could be exchanged between even constituent countries to a free trade area, a careful "Definition of origin" of the goods is required. So fundamental is the principle involved in this aspect that the Working Party of the Council of O.E.E.C. contained this statement in their report:

> "The need to define the origin of products stems from the fact that, in a Free Trade area, each participating country will retain its national tariff on imports from third countries. **In a free trade area only products originating in the area are entitled to duty free treatment when traded between the constituent countries."**

Certain unavoidable variations of this principle were suggested but it was concluded that:

> "The fact that goods of external origin on entering any area country have paid the duties of that country cannot of itself confer the nationality of that country on the goods in question, if they are exported in their original state, or after processing to another area country."

It is evident that even the rigid principles stipulated in relation to the Free Trade area will, of a necessity be varied. It is nonetheless quite clear that no easy arrangements will be made available to Americans or others to use a constituent country of the free trade area as either a dumping or a manufacturing/re-export base.

As far as manufacturing is concerned, if any group were interested in practicing this and were permitted to do so for free trade or other commercial purposes, they could be granted the facilities in any of the Scandinavian or German free ports. Free port manufacturing however has never reached significant proportions even on the very doorstep of the vast European market. It is unlikely therefore that manufacturers will avail themselves of this proposed facility in the Shannon Estuary which is situated on the western seaboard of Europe.

Milford Haven

Another possibility that has been promoted is that the Shannon Estuary could be utilised in the same way as Milford Haven. This does not take into consideration that Milford has many advantages both physical, geographical and commercial over the Shannon. The principal point is that it provides a deep water port in one of the most extensively industrialized areas in the world. It could also provide in conjunction with other ports, the oil needs for a population of approximately 50,000,000 people. The area can also be employed to accommodate the giant ore carriers whose cargoes would feed the vast steel and iron foundries in industrial South Wales and other British steel making centres. It is unlikely that shippers could be persuaded purely because the Shannon has deep water to use this isolated area as a storage centre when transhipments would be both inconvenient and expensive.

European and World Free Ports

Finally, regarding the question of the success of free ports in other parts of the world, this has been constantly argued as being an indication that such success could be repeated in Ireland. There is however, no justification for this type of reasoning. The fact that free ports in the Far East, the United States, or Mediterranean areas are successful is no criterion that their functions would be in demand in north-west Europe, which is the only area that the Shannon could cater for. It has already been pointed out above that there is no demand for even the manufacturing or re-export facilities at present available in Europe and ships are not likely to be diverted to the Shannon and so create such markets.

Summary

There are uses for Irish ports which are at present being very fully explored by the Maritime Institute of Ireland. The outcome of these investigations may well demonstrate that notwithstanding anything that has been written here, Ireland because of her geographical situation can make a valuable contribution to the commerce of Europe. It is however quite certain that the suggestions which have been proffered as far as the Shannon is concerned do not stand the test either with regard to commercial demand of to the idea that the Estuary will be required because of the inability of European ports to adjust themselves to changing ship sizes.

Erratum.—In the letter by D. McClean published in last month's issue referring to his article "Marine Surveying at the Port of Newcastle," line 4 in the fourth paragraph should have read "varying from 0 to 2-ft." and not "0 to 2-in." as printed.

Flexible Steel Dolphins and Kindred Structures

Survey of Recent Developments in the Netherlands*

By Ir. Tj. J. RISSELADA
(Chief Engineer of the Public Works Department of Amsterdam, Chief of the Department of the Harbour Works.)

(a) Introduction

IT will interest the readers of the article on dolphins at the port of Amsterdam, published in the June and July issues of the "Dock and Harbour Authority" in 1954, to make themselves acquainted with the development since then. It will be all the more interesting if the experience gained at Rotterdam and elsewhere is also included in this survey.

In the development of the steel elements for dolphins and their accessories a distinction may be made between those applied in structures for berthing big ocean-going ships on the one hand, and those for berthing ships such as coasters and inland craft on the other.

During the last few years the size of tankers has been markedly on the increase, and it is an open question whether the technical development of dolphins has been, or will be, able to keep step with that increase, so as to ensure safe berthing and efficient handling of these mammoth ships which are so costly to purchase and to run.

Here the problem of economy is secondary, although naturally it is not a matter of indifference to the owners of those structures (which may be rather expensive in themselves) if money can be saved on them without sacrifice of quality.

Economy plays a relatively greater part when providing berths for smaller ships and for these structures various solutions are generally possible.

In order to judge between the different solutions for any one case correctly it is not sufficient merely to examine whether they satisfy the requirements with regard to dynamic and static loads; they should also have the necessary flexibility which is required to perform their task adequately and safely.

Flexibility may be measured by the deflection under a force of one ton acting at a certain level—preferably corresponding to the place where the ship touches the structure at low tide as it is being moored.

Cost—whatever it may amount to—being always significant, it is important to analyse the items comprising the total. These are, cost of materials, of transport, of construction at the site and of finishing.

Depending upon the distance of the site from the fabricator's yards or mills and the circumstances in which the structure has to be erected, the three latter items are likely to play the greatest part.

(b) Analysis of Development

To obtain a better insight into recent developments, an examination will be made as to what possibilities exist to satisfy the increasingly exacting requirements. For that purpose the nature and the magnitude of the relevant factors will be analysed.

To simplify the problem, tendencies only being under review, the dolphins will be considered as fixed in the ground, the depth of fixity being assumed, whilst the influence of the soil and that of the deformations below the point of fixity are ignored.

Criteria are:

1. flexibility
2. strength (static load); and
3. ability to absorb energy (dynamic load).

Starting from the formulae as to 1:

$$f/P = \frac{l^3}{3EI},$$

as to 2:

$$P = \frac{M}{l}, \text{ and}$$

as to 3:

$$A = \frac{P^2 l^3}{6EI}$$

where f = the deflection at the point of application of the force P
P = the applied static force
A = energy absorbtion
l = the distance between the point of application of the force P and the point of fixity of the structure in the soil
E = modulus of elasticity
I = moment of inertia,

the general formulae can be derived:

$$(1a)\quad f/P = \alpha \frac{l^3}{Fe^2}$$

$$(2a)\quad P = \beta \frac{Fe\sigma}{l}$$

$$(3a)\quad A = \gamma F\sigma^2 l$$

where $\alpha = \frac{\left(\frac{e}{i}\right)^2}{3E}$

$$\beta = \frac{1}{\left(\frac{e}{i}\right)^2}$$

$$\gamma = \frac{1}{6\left(\frac{e}{i}\right)^2 E}$$

where F = cross-sectional area of steel
e = distance from neutral axis to extreme fiber
i = radius of gyration
σ = yield stress

for circular sections $\frac{1}{\left(\frac{e}{i}\right)^2} = \frac{1}{2}$

for broad-flange PSp-sections the value of $\frac{1}{\left(\frac{e}{i}\right)^2}$ varies from 0.2 to 0.67 depending on the number and type of sections used and on the angle at which the force acts on the dolphin (see Fig. 1).

It should be stressed that the formulae stated above *are not to be used for the calculation of the dolphins themselves* but only serve as an approach in order to investigate the general tendencies of the problem.

These are that in order to satisfy severe requirements σ has to be large, F has to be large for (2a) and (3a) but small for (1a) and e has to be large for (2a) but small for (1a).

Hence, for the development, it is important to raise σ whilst with regard to F and e for (1a) and (2a) a compromise should be found. Although that compromise will be different in different cases, nevertheless, considering that (1a) contains the square of e, it is obvious that first of all the solution will have to be sought by choosing a large F which according to (3a) works out favourably on A. As will be seen later, the increase of F should be kept within certain limits for economic reasons.

It is true that choosing a smaller e for the sake of flexibility results in slenderer sections; since, however, it inevitably leads to using more material, care will have to be taken not to make exaggerated demands with respect to flexibility. The more so because a reasonable flexibility is soon reached, as the depth of fixity appears to the third power in formula (1a)*.

Whereas until recently St 37 was the normal steel used in civil engineering and St 52 the high grade product, with yield stresses of respectively 14 and 22.7 tons per sq. in. (respectively 2,200 and 3,600 kos. per sq. cm.) now, thanks to metallurgical development, steels of a still higher grade are readily available at reasonable prices. In consequence we can now employ an extremely high-grade steel having an ultimate tensile stress from 44.5 to 57.2 tons per sq. in. (7,000 to 9,000 kos. per sq. cm.) and a yield stress of at least 35.7 tons per sq. in. (5,630 kos. per sq. cm.) for seamless tubes.

Thanks to the development of welding these very high-tensile steel tubes can be employed as structural elements which, besides having great strength and the ability

*The main part of this article was written in May, 1957

* Actually l is not constant, but increases inter alia with the rigidity of the pile, i.e. with the e of the section. However, the proportional increase of e when using a larger section, even where the soil is very compact, always exceeds the corresponding increase of l, likewise expressed proportionally. (Only where the soil is rocky, does l not increase.)

Flexible Steel Dolphins—continued

to absorb energy, have also great flexibility due to their slenderness. Hence even for smaller dolphins, steel piles can compete technically and economically with wooden ones.

Of course this does not mean that (hard) wooden piles should be banished from this field of civil engineering. On the contrary, it will remain more attractive to use timber for many smaller structures, such as fenders, protecting piles and smaller jetties.

Due to economic considerations the manufacture of seamless tubes is restricted to those with a diameter of at most 21½-in. (546 mm.) and a thickness of wall of at most 1⅜-in. (35 mm.).

The highest grade steel, so-called "Sonderstahl" (special steel) roughly corresponds with St 52 (yield stress of 22.7 tons per sq. in.).

The very high-grade steels used are silico-manganese steels, containing 0.8—1.6% manganese and 0.20—0.55% silicon. They do not contain more than 0.05% phosphorus and sulphur, and not more than 0.2% carbon; 0.1—0.2% vanadium may be added to raise the tensile strength and yield point, or 0.3—0.4% carbon for the same purpose. In each case, however, the material should be subject to a heat treatment.

Below are summarised the possibilities

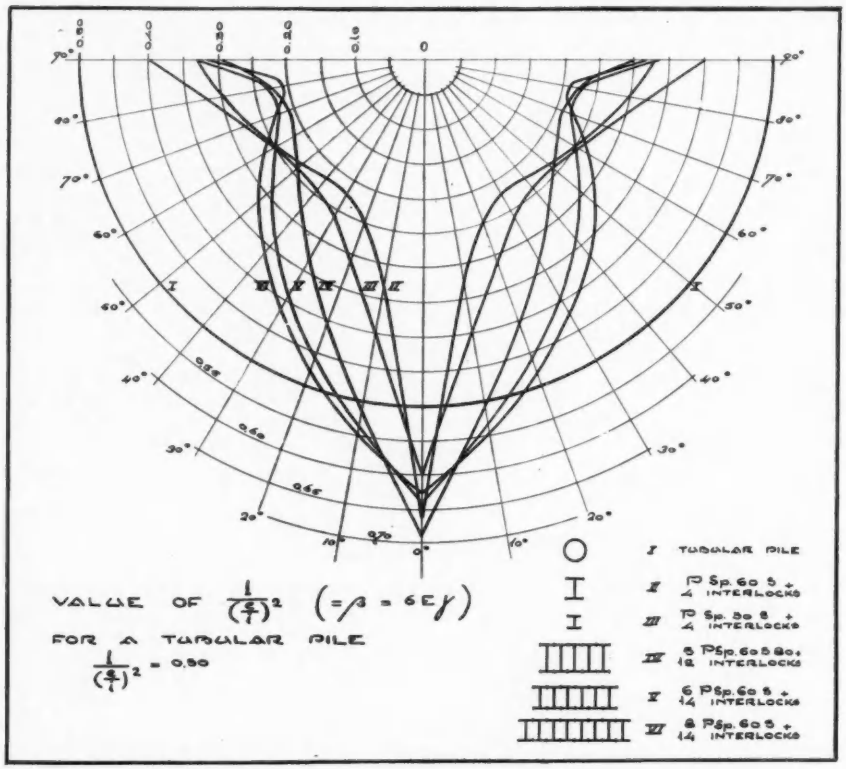

VALUE OF $\frac{1}{(\frac{e}{i})^2}$ $(=\beta = 6E\gamma)$
FOR A TUBULAR PILE
$\frac{1}{(\frac{e}{i})^2} = 0.90$
I TUBULAR PILE
II PSp. 60 5 + 4 INTERLOCKS
III PSp. 30 8 + 4 INTERLOCKS
IV 8 PSp. 60 5 80 + 12 INTERLOCKS
V 6 PSp. 60 5 + 14 INTERLOCKS
VI 8 PSp. 60 5 + 14 INTERLOCKS

Fig. 1. The value of $\frac{1}{\left(\frac{e}{i}\right)^2}$ for a tubular pile and for some wide-flange sections when the forces act at a certain angle.

With non-seamless tubes the maximum thickness of the wall is 2 or 2 3/16-in. (50 or 55 mm.). Starting from the practical formula $d \geqq \sigma \times 0.2 \times R \times 10^{-5}$, and allowing the minimum thickness of wall to prevent buckling, a maximum diameter of about 100-in. (2,500 mm.) is obtained.

The highest grade steel for making non-seamless tubes is steel with a yield stress of 28.6 tons per sq. in. (4,500 kos. per sq. cm.).

The greatest depth of wide-flange beams is about 23⅝-in. (600 mm.) and the greatest thickness of their flanges ⅝-in (16.5 mm.). By welding plates on to the flanges their thickness can be raised to about 1¾-in. (45 mm.). Because of the interlocks these plates cannot be applied over the entire breadth of the flanges.

offered by the two types of pile applied most frequently, viz. those whose cross-section is either circular or wide flange-shaped.

1. **Circular section.**
   - (a_1) pure circle: seamless Mannesmann tubes
   - (a_2) pure circle: non-seamless Mannesmann tubes
   - (b) polygon: Peine sections.

2. **Wide flange-section.**
   Peine sheet pile sections.

(sub 1 a_1) Diameter up to 21½-in. (546 mm.).
Length such that the maximum weight of the tube is 2—4 tons ingot weight. Thickness of wall minimum 1/16-in. (1.5 mm.) and maximum 1⅜-in. (35 mm.).
Grade of steel: yield stress 14, 22.7, 29.2 or maximum 35.7 tons per sq. in. (2,200, 3,600, 4,600 or maximum 5,630 kos. per sq. cm.).
Tubes of the latter grade of steel have walls at most 11/16-in. (18 mm.) thick.

The piles may be composed of sections, the permissible load of which corresponds as far as possible, by variation of the thickness of the wall and the grade of the steel, to the maximum moment for the section in question.

The welds in very high-tensile steels should be stress relieved, which is practicable only in the factory. The moment at the head and the point of the pile being very small, no very high-tensile steel need be used there, so that there, welding may be done at the site.

(sub 1 a_2) Diameter up to about 100-in. (2,500 mm.).
Length is unrestricted. The length of the composing parts depends on the diameter and thickness of the wall up to the limit of the weight of the ingot. Thickness of the wall maximum 2 3/16-in. (55 mm.) (practically).
Grades of steel: yield stress 14, 22.7 or maximum 28.6 tons per sq. in. (2,200, 3,600 or maximum 4,500 kos. per sq. cm.).

With this material too, the piles may be composed of sections which, by variation of the thickness of the wall and the grade of steel relative to the permissible load, are adapted as much as possible to the maximum moment for the section in question. The parts are made of curved sheets so that besides transverse seams there are longitudinal ones.

All the welds are heat treated in the factory so as to leave no internal stresses. As a rule the end sections are not made of very high-grade steel.

(sub 1 b) Dimensions (see Figs. 2, 3, 4 and 5); composed of steel sheet piles. Steel grades St. 37 and "Sonderstahl" (about St 52) with yield stresses of respectively 14 and 22.7 tons per sq. in. (2,200 and 3,600 kos. per sq. cm.).

The adaptation of the section of those piles to the maximum moment is restricted to the welding on of plates or T sections at the position of the greatest moment.

(sub 2) Dimensions (see Fig. 6); usually applied as I⩧I

The depth may be increased without increasing the quantity of material used, by adoption of castellated sheet piles (Fig. 7).

Some augmentation of this section is possible by welding plates or T sections on to the flanges.

A better solution can be reached by adapting the length and number of the piles to the required moment of inertia.

Flexible Steel Dolphins—continued

In addition to the design and fabrication the driving of the piles needs careful consideration. The larger the sections, the greater the difficulties. First of all, handling the objects (which are getting progressively heavier) and moving them into their right places, demands more accurate equipment as well as bigger sheerlegs and lifting plant (see Fig. 8). Moreover, the greater

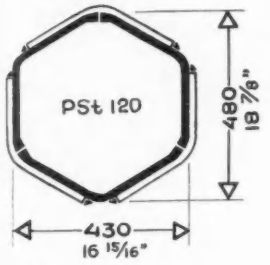


Fig. 2.

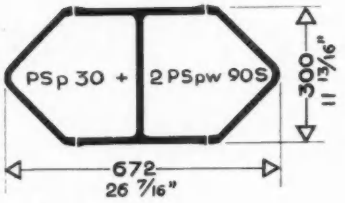


Fig. 3.

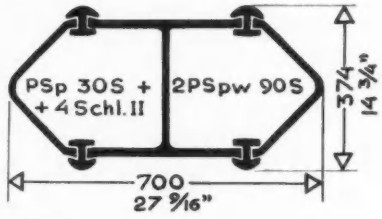


Fig. 4.

point-resistance and skin friction of the larger piles would necessitate the use of heavier pile driving equipment, sometimes even of special appliances. Consideration must also be given to the fact that, due to the larger sections and consequently the greater rigidity, the driving depth increases, which also makes driving to the full depth more difficult.

Owing to the refinement of the methods of investigation of soil mechanics the resistances to be expected can be determined fairly accurately.

When driving hollow tubes, experience has shown that soil may plug the tube near the point, causing the open tube to act at a given moment more or less as a closed one. Something like that occurs when driving double or single wide flange-sections beside each other.

The skin friction can be reduced by applying a cutting edge or knives. It is true that this increases the area of the point and consequently its resistance but that is more than offset by the reduction of skin friction by pushing away the soil. For the larger sections this usually is not sufficient and more effective measures will have to be taken. In order not to endanger the fixity of the pile in the soil these measures should be confined to the reduction of the friction on the inside of the section. This can be achieved by removing the soil within the section with the aid of a self-emptying borer or by loosening the soil by jetting.

The former method badly retards the driving, which is undesirable because the pile should be kept moving as much as possible.

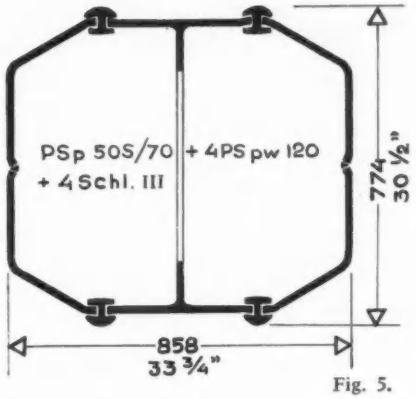


Fig. 5.

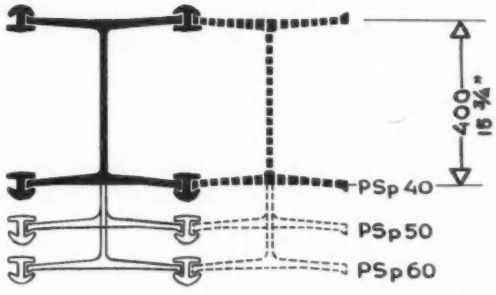


Fig. 6.

The latter method requires some care, because jetting must not be continued so far down that underneath the point of the pile an upward current of water along the outside of the pile is caused. Care has to be taken that the nozzle of the lance never reaches lower than, for instance, 3-ft. (1 m.) above the point of the pile. The distance can be reduced by arranging the jet-installation so that the stream of water shoots upwards.

The conduits can be led through openings in the driving-cap or they can be welded firmly to the inside of the pile—in which case they are lost—so jetting need not interrupt the driving process.

The driving of piles has been facilitated by the improvement of the driving apparatus; not only its absolute, its effective capacity too, is increased. When using modern, often floating pile driving plants, handling is also easier.

Whereas the use of a steam-hammer is to be favoured even for the driving of small piles, it is essential for driving bigger ones. In proportion to the size of the pile and the resistance in the ground, semi-automatic steam-hammers are now available with a total weight of 13,230; 20,940 or 30,860 lbs. (6,000, 9,500 or 14,000 kos.) and a falling weight of the hammer of respectively 9,920; 14,880 and 22,050 lbs. (4,500, 6,750 and 10,000 kos.). With a drop of 4-ft. (1.25 m.) the number of blows is respectively 35, 34 and 33 a minute.

(c) Economic Considerations

When designing a dolphin for a certain purpose, the first question will be what type of section is most suitable for the end in view.

To find an answer one introduces certain values for the rope pull and the wind or wave pressure when static loads are under consideration, and for the mass, berthing velocity and direction of collision of the vessel as regards the dynamic loads.

The formulae which are to be considered are represented by 2a and 3a. Which one of those will be the determining factor depends on the case considered. It is known by experience in the Netherlands that usually the static load will be the determining factor when dealing with structures for berthing the bigger sea-going ships (formula 2a) whereas the dynamic load will be more critical for the berthing accommodation of the smaller vessels (formula 3a); compare the tables V and VII in which the determining factors are printed in black type. As regards super-tankers of the future, it seems somewhat premature to give any indication since too much depends upon the circumstances of each case.

Approaching this problem from the economic point of view and considering *the static load*, formula 2a may be written as follows:

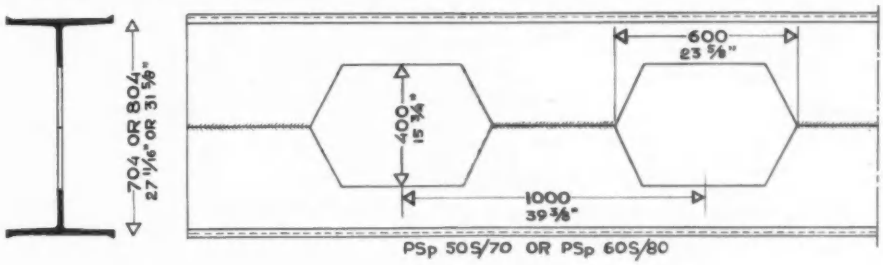


Fig. 7.

$$(2b)\quad P = \beta \frac{Ge\sigma}{\nu\mu l^2}$$

where G = the total weight of the steel piles
ν = a coefficient of adaptation and
μ = the specific gravity of steel.

Flexible Steel Dolphins—continued

The coefficient ν should be introduced to express the saving of material to be attained by adaptation of the cross-sections to the required moment of resistance. ν amounts to e.g. 0.75 for a tubular pile and to about 0.8 in the most favourable case for PSp-piles.

By starting from a constant required strength for various sections, and by equating the right-hand sides of equation 2b, an equation is found, in which the relation between the required quantities of steel is expressed.

To introduce the cost of material (C) the weight of the required steel piles must be multiplied by a cost factor ζ. Based upon the prices of the steel grades employed ζ is assumed to be 1 for steel with a yield point <22.7 tons per sq. in. (3,600 kos. per sq. cm.) and about 2.5 for steel with a yield point >22.7 tons per sq. in. (3,600 kos. per sq. cm.). Finally the equation becomes:

$$\frac{C_1}{C_2} = \frac{\zeta_1}{\zeta_2}\,\frac{G_1}{G_2} = \frac{\zeta_{s1}\,\beta_2\,\nu_1}{\zeta_{s2}\,\beta_1\,\nu_2}\,\frac{e_2\,\sigma_2\,l_1^2}{e_1\,\sigma_1\,l_1^2}$$

Considering the *dynamic load* formula 3a may be written as follows:

$$3b)\quad A = \gamma\,\frac{G\,\sigma^2}{\nu\,\mu}$$

By starting again from a constant required strength for various sections in the same way as with the static load an equation is found expressing the relation between the required quantities of steel.

After introducing the cost factor ζ the relation between the cost of material $\left(\frac{C^1}{C^2}\right)$ in this case can be expressed by the following equation:

$$\frac{C_1}{C_2} = \frac{\zeta_1\,G_1}{\zeta_2\,G_2} = \frac{\zeta_1\,\gamma_2\,\nu_1\,\sigma_2^2}{\zeta_2\,\gamma_1\,\nu_2\,\sigma_1^2}$$

In the diagrams (see Figs. 9 and 10) a comparison is made between the cost of piles for structures consisting of a single tube of very high-grade steel (C_1) and that of similar structures of PSp-sections (C_2), the external forces acting not only normal to the front of the dolphin (0°) but also at a certain angle.

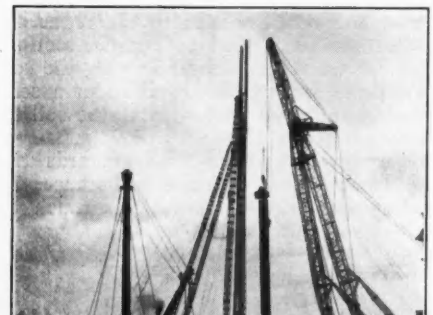


Fig. 8. Handling a Mannesmann tube for a dolphin of the "Amatex" berth II. The tube has been brought into the right position by the floating sheerlegs so that the driving cap can be placed.

As regards the piles of the smaller structures, tubes are considered with a diameter from 17½-in. to 21½-in. (from 445 to 546 mm.) — $\sigma = 35.6$ tons/sq. in. (5,600 kos./sq. cm.) —and the PSp-sections 2 PSp 30 S, 3 PSp 30 S and 2 PSp 40 L—$\sigma_2 = 22.7$ tons/sq. in. (3,600 kos./sq. cm.).

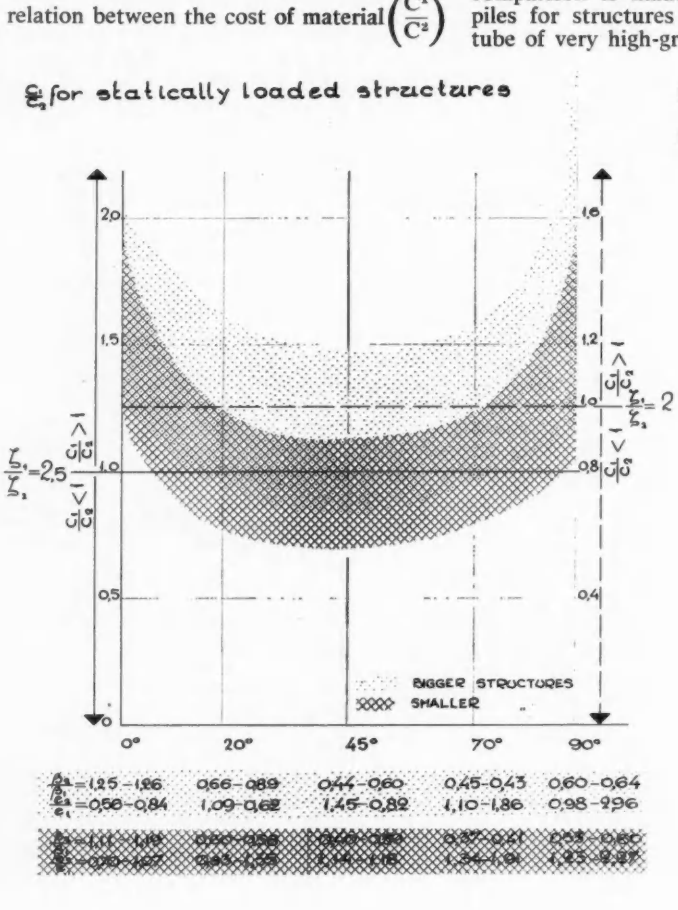
As regards the piles of the bigger structures tubes have been considered having a diameter from 31½-in. to 47¼-in. (from 800 to 1,200 mm.) — $\sigma_1 = 28.6$ tons/sq. in. (4,500 kos./sq. cm.) — and the PSp-sections 3 PSp 60 S, 4 PSp 60 S, 5 PSp 60 S and 6 PSp 60 S — $\sigma_2 = 22.7$ tons/sq. in. (3,600 kos./sq. cm.).

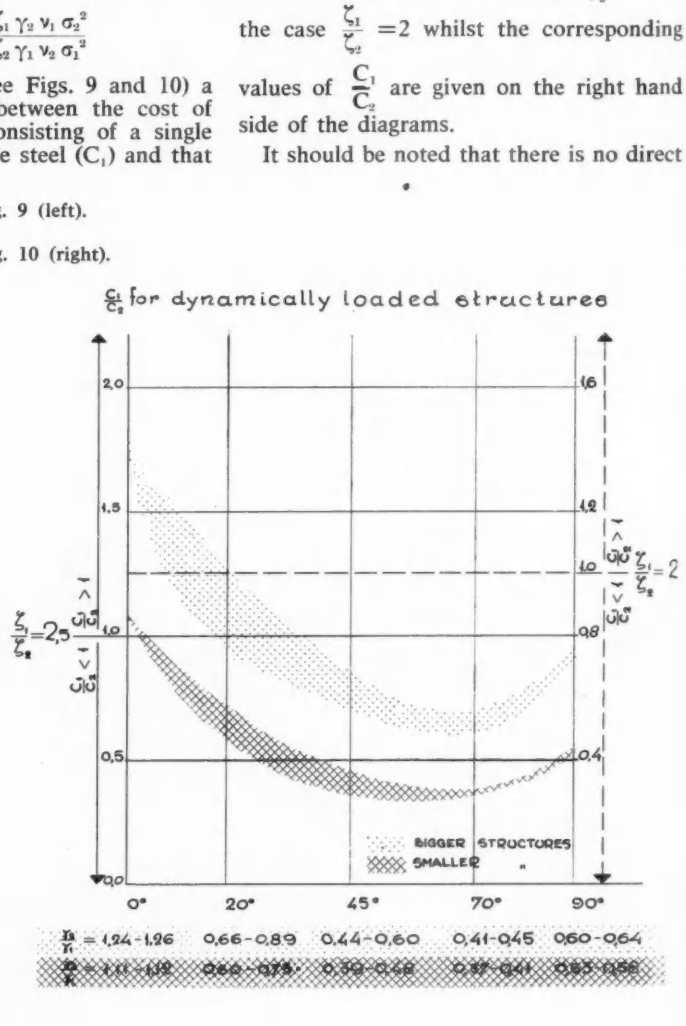
Along the ordinate on the left hand side of the diagrams are given the values of $\frac{C_1}{C_2}$ based on the assumption $\frac{\zeta_{s1}}{\zeta_{s2}} = 2.5$ which is in accordance with the present market situation in the Netherlands. To show the influence of a change in the value of $\frac{\zeta_{s1}}{\zeta_{s2}}$ a dotted line is drawn indicating $\frac{C_1}{C_2} = 1$ for the case $\frac{\zeta_{s1}}{\zeta_{s2}} = 2$ whilst the corresponding values of $\frac{C_1}{C_2}$ are given on the right hand side of the diagrams.

It should be noted that there is no direct

Fig. 9 (left).

Fig. 10 (right).





Flexible Steel Dolphins—continued

relation between the assumed values of the dynamic and static loads, whilst it should further be borne in mind that the most unfavourable directions of the static forces and of the dynamic forces are not likely to coincide. In both cases the values of $\frac{C_1}{C_2}$ will be lowered to some extent if the costs of piledriving, bracing, construction, etc., are taken into consideration. It will be clear that this remark is only true when the comparison is between a single-tube structure and one consisting of a number of broad-flange sections.

In the above analysis it has been assumed that the structural elements considered always come up exactly to all that is required by the dynamic load and at the same time no less precisely to the static requirements. Actually the structure will have to fulfil more or less exactly both requirements at the same time. To meet these demands will not always be easy in practice. Here then is an advantage in making use of that structural element which is most adaptable.

If the load on the dolphin always acts at right angles to the front of the structure the most economic sections to be used with regard to energy appear to be the wide flange sections.

No sooner, however, do the forces act at any other angle than at right angles, then the advantages of the circular section become obvious because its strength is equal in all directions, whilst stresses are distributed very evenly.

As regards a structure consisting of broad-flange sections the resistance is reduced when loaded in any direction other than normal to the face. This reduction may be as much as 65% (if the force acts in the most unfavourable direction) for dynamic loads† as is indicated in diagram (Fig. 1) for various sections and—depending on the number of interlocked piles—from 40% to 10% for static loads.‡ The greater quantity of steel required due to these reductions is partly offset by the lower cost per ton of these sections.

The flexibility of a tube is usually smaller than that of a structure constructed of wide-flange sections loaded along the Y-axis, but far greater than that of such a structure loaded along the X-axis—in which direction structures consisting of wide flange sections can be considered as comparatively rigid. To obviate this rigidity the panels of piles could be split up into smaller units, though such a solution requires a greater quantity of steel.

The advantage of a polygonal section compared with a tubular one can only be realised in structures for small ships because of its restricted dimensions. If more than one single pile is required the additional costs, such as those for bracing, construction etc. will play an important part.

In special circumstances, e.g. if one can be assured that the greatest forces are always applied in one single determinate direction it may be advantageous to use a section of the type shown in Fig. 5. Although this section is stronger than the above-mentioned polygonal one, yet a certain number of the latter should always be used in larger structures. Therefore the application of a bracing which is rigid in respect of torsion is inevitable.

As regards the tubular sections, the survey has shown that a wide range of tubes is available varying in diameter as well as in wall thickness. Due to this and to the extremely high yield points of the steel grades supplied, practically any problem can be solved in an economic way by using a single tube, making for a structure which is constructionally very simple.

When making use of other sections, a number of piles will nearly always have to be applied. In order to justify the choice of such a solution the disadvantage of higher constructional costs must be compensated for by lower material costs or by other special advantages.

The argument that a structure with more piles would be safer in the event of failure of one of them due to collision damage seems of doubtful value since, as a result of the torsional rigidity of the bracings, all the piles are practically equally loaded. If one of the piles fails one cannot rely on the remaining smaller number being still capable of supplying the necessary resistance.

The case is different if a very broad or heavy structure is desired for operational or even "psychological" considerations; then the use of several elements is inevitable.

The experience in the Netherlands affirms that, under the circumstances prevailing there, in cases where the structure is subjected to static loads or to loads acting from one direction only the application of PSp-sections is more economic, but in those cases where the structure is subjected to dynamic and static loads acting from various directions the application of a single tube is generally more satisfactory.

Whether this will also apply to the very big dolphins for berthing mammoth tankers has still to be proved.

(To be continued)

† In practice the most unfavourable direction is not the critical one since actually vessels strike the dolphin at angles which—except perhaps in very special situations or when relatively small ships are concerned—are never more than 5° from the normal to the face under quiet conditions (sheltered berth, no strong currents)—or virtually no more than 10° in rough water. An angle of 20° to the normal therefore can be considered as the absolute limit.

‡ The view that the static load from windpressure is less when the wind strikes the vessel at an angle to the normal is incorrect. On the contrary—due to the pull of the springs—it can increase by about 10%. For this reason when establishing the loading on the structure the windpressure should not be underestimated.

Tanker Discharge Dock, Newport, Mon.

New Depot for Shell-Mex and B.P. Limited

(Specially Contributed)

In the article on the history and development of the Port of Newport, Mon., published in the Dock and Harbour Authority of August 1957, the plan of the port shown on page 124 includes an area at the North Western end of the South Dock marked "Boomed Tanker Dock." This boomed area has now been completed for Shell-Mex and B.P. Limited, and is in use for the discharge of such vessels. A note on the proposed depot is also given on page 127 of the same issue.

The available area was about 400-ft. long by 120-ft. wide, measured from the dock edge, and the first point to be considered was the size of ships requiring to use the depot. It was stated that the largest vessels to be used would have a carrying capacity of about 800 tons, would be about 202-ft. long, have a beam of 31-ft., and a maximum draught of 15-ft. Therefore, it was thought sufficient to provide a clear width of 49-ft. within the boom and a length of about 350-ft. between the dock edge and the inside of the boom gates. The face of the discharging jetty would, however, have to be set in about 60-ft. from the dock edge to provide sufficient depth of water for the vessels, there being sloping banks at the side and end of the North Dock in this neighbourhood.

In considering the type of boom required it was necessary to have regard to the levels of the water usually maintained in this dock. The water is maintained within certain limits by impounding, and the following table shows the levels to be expected, referred to Dock Datum (i.e. −50 O.D.):

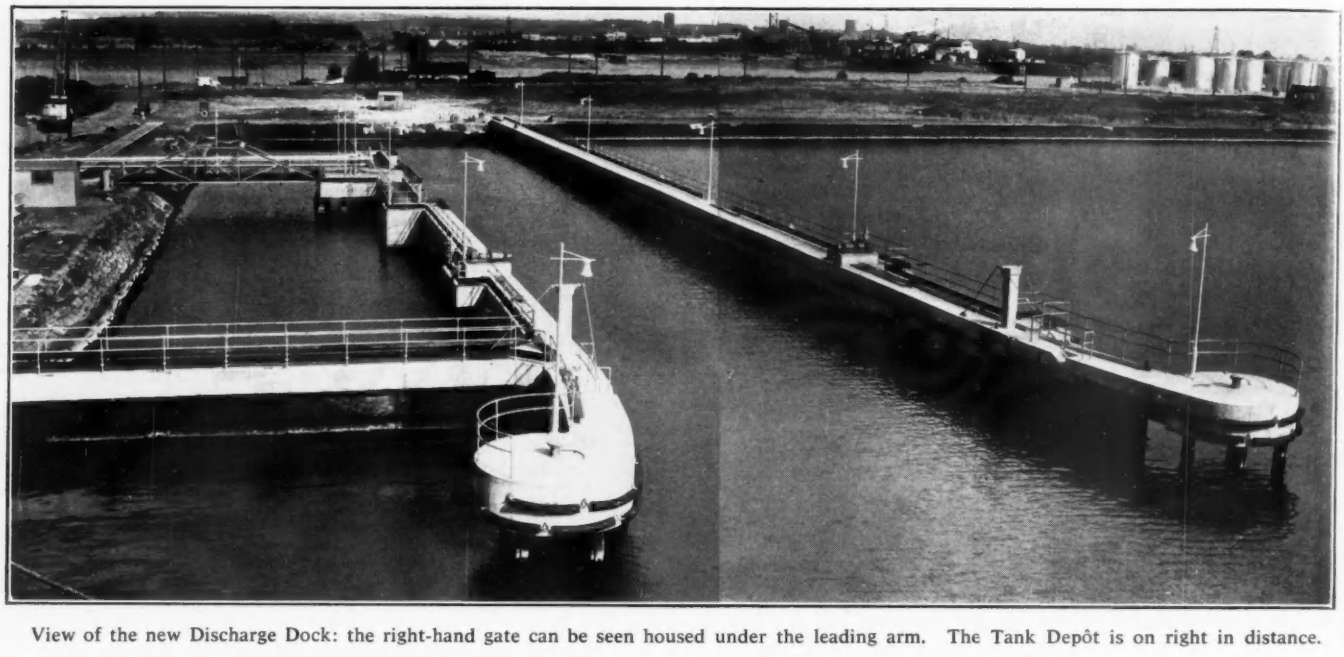
Top of Alexandra Dock gates ...	75.07
Normal Dock level	73.70
Mean High Water Springs	70.55
Dock bottom at 60-ft. from edge ...	54.70

In addition, under the influence of certain winds a range is experienced in the dock, which, owing to its length, can be as much as 2-ft. at the Northern end, and, after consideration of this fact and of the levels mentioned above, it was decided that it would be sufficient to provide a boom between the levels of 70.55 and 77.24, and this was approved by the Docks Board of the British Transport Commission.

Several types of floating or fixed booms were considered, and it was finally decided that a fixed boom between the levels above mentioned would be the most economical and free from trouble.

As regards the material of which the boom would be constructed, timber would obviously have been the easiest, but, from information received from the local Authorities, it was not thought that even the use of greenheart would be sufficiently

Tanker Discharge Dock, Newport—continued



View of the new Discharge Dock: the right-hand gate can be seen housed under the leading arm. The Tank Depôt is on right in distance.

permanent. It was, therefore, decided that a steel boom would, under all the circumstances, be most suitable, and considerable investigation was made to ascertain the best method of preserving the steel in sea water.

It will be seen that once the boom plates have been fixed they will not be subject to rubbing, and it was finally decided that by coating them with a non-oxidising preservative a long life would be ensured. It was ascertained that steel dock gates coated with a similar material had been removed after having been in use for 18 years, and the steel work was found to be practically in its original condition. It was, therefore utilised to coat the steel work throughout.

Discharging Jetty

The bottom of the South Dock being shelving it was necessary to establish the face of the jetty about 60-ft. from the bank. The main jetty-head consists of a concrete platform 3-ft. thick supported at the front on three cylinders, each with a pair of piles driven inside and at the back on three pairs of piles, one of each pair being driven on the batter.

The deck of the jetty-head measures 32-ft. long by 22-ft. wide, and on each side of it a flexible dolphin is situated one foot proud of the jetty face, and connected to the main platform with flexible articulated gangways. The dolphins are each supported on four Larssen box piles No. 5 section.

A Bean bollard was placed in the front of each dolphin and the whole length of the structure outside to outside of dolphins is 120-ft.

The jetty head was connected with the shore by a steel gangway with a timber deck, the gangway being 13-ft. wide and 47-ft. 6-in. long carrying the five pipe lines. Space for additional lines is available.

Boom Structure

The main Southern gangway carrying the boom is about 360-ft. long and consists of a heavy deck forming a horizontal beam carried on pairs of 14-in. by 14-in. pre-stressed piles 55-ft. long spaced at 12-ft. centres, one of the piles being driven on the batter. The gangway decks on the North side are of lighter construction, but are supported on 16-in. by 16-in. pre-cast reinforced concrete piles. On both sides winch platforms are provided about 50-ft. inside the gates to carry the operating machinery, and, outside the gates, flexible arms each carried on 8 No. Larssen piles No. 3 section, these arms having a circular round-head each carrying a Bean bollard and lamp standard. At all junctions between the flexible arms and dolphins and the non-flexible structures, spaces of six inches were left which were bridged by hinged plates.

Booms and Gates

The boom plates which were fabricated in panels 12-ft. long by 5-ft. 3-in. wide, were secured by strap bolts to the raking piles of the South gangway, and extended on that side from the shore to the heel of the gates, a distance of about 360-ft. On the North side they were secured to the vertical piles supporting a walkway leading straight to the shore—a length of about 40-ft.

Underneath the South gangway the plates make contact with the underside of the heavy concrete deck beam, a seal being formed by asbestos packing inserted between the tops of the panels and the concrete, but for the short length on the North no such contact was necessary, the plates being made wide enough to cover the vertical distance specified in the early part of this article.

Gates were of all-welded construction and carried synthetic rubber sealing blocks at the heel and mitre, such blocks not being affected by oil. Details of the gates are shown on the drawings.

Operation is by small electrically driven winches exercising a pull of ½ ton on the operating ropes and having two barrels, each of which can be operated by a central clutch or allowed to run freely. Thus, in opening, or closing, one barrel is disconnected but controlled by a brake, whilst the other is operating the opening, or closing rope, as the case might be.

In order to avoid fouling vessels entering the depot it was necessary to ensure that, when the gates were open, the ropes would be on the bottom of the dock, and this was arranged by terminating the closing ropes with a length of chain coupled to the gate. The weight of the chain causes it to hang vertically when the gates are open, thus carrying the ½-in. diameter wire rope to the bottom at that end. At the end remote from the gate the wire rope passes through a running weight sufficient to ensure that the rope at this end also is carried to the bottom, and this device works quite satisfactorily. The lengths of the chains are such that they do not quite reach the ground. It was necessary, of course, to provide an extra length of rope on the two closing barrels of the winches to ensure that a sufficient length was available to hang vertically each side and lie on the dock bottom. The ropes are led from the winches along the deck by means of roller guides until they reach the point where they must pass vertically downwards. At the required depth they pass through the hinge pins of swivelling pulley guides so that they can pass from a

Tanker Discharge Dock, Newport—continued

vertical to a horizontal direction and, at the same time, can adjust themselves to the differing angles as the gates are swinging. Twin pulleys are fitted at this point so that the ropes cannot come out of the pulley grooves.

The rate of opening and closing is 20-ft. per minute, and it will be seen that the gates can be opened, and closed, in a very short time. When open they fit in recesses under the flexible arms, and, in order to ensure that there is at no time an undue stress on the ropes, either during operation or when the arms are deflected under pressure, springs are fitted at the junction between the ropes, or the chains, and the gate, these being coil springs totally enclosed in cases filled with heavy oil.

The operation of opening or closing is as usual with dock gates, but in this case, one leaf which carries a projecting flange plate must, in closing, be kept behind the other leaf and only overtake it when the closing has been almost completed. In practice, this presents no difficulty and the operators very quickly become expert. When closed, pressure is maintained on the ropes, since there is no water pressure on the gates themselves.

Each barrel of the winches is controlled by a separate brake and as soon as the gates have been opened, or closed, these are screwed down and the winches set for the reverse operation before being left. In case anything should go wrong with the mitring operation, in closing, stopper chains are fitted so that no damage to the gates can result.

General

Bean bollards were fixed in various positions along the gangways as shown, and circular rubber fenders are provided on both sides wherever a vessel is likely to make contact with the gangways. They are also provided on the jetty head and dolphins. Two bollards in suitable positions on shore are also provided for use if, and when necessary due to exceptional circumstances.

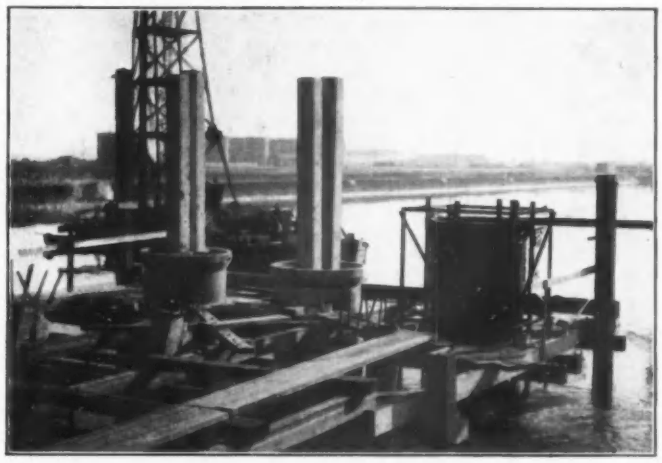
Four special red lights and beacons outside the South gangway have been provided in order to ensure sufficient indication of its presence should be given to other shipping. All electrical gear including winch motors, are to special flameproof standard.

Construction

The pile driving operations were carried out afloat by means of two piling rigs mounted on barges, the piles being fed to them from the shore with a travelling shore-based derrick crane. In the initial stages of the contract temporary timber piles were driven to assist in the subsequent positioning of the barges and the fixing of timber guides for the permanent piles, the majority of which were satisfactorily driven with a Delmag D.12 diesel hammer.

The three cylinders of the jetty head were plumbed within a fabricated steel guide and sunk by a combination of grabbing from within with an orange peel grab and weighting from above. A penetration of 11 feet was obtained.

A view of the jetty head upon completion of the sinking of the first cylinder. In the foreground can be seen the three pairs of vertical and raked reinforced concrete piles at the rear face of the jetty head.



A view of the jetty head just before the completion of the sinking of the third cylinder. Inside the two completed cylinders can be seen two pitched and partially driven reinforced concrete piles. In the background is one of the two piling barges with the piling rig mounted on it.

Upon the completion of the permanent piling and sinking of the cylinders, shuttering was fixed to the jetty head, dolphins, flexible arms and north and south gangways, the reinforcement fixed and the concrete placed by means of a shore-based pump.

The final stages of the contract consisted of placing the steel fabricated bridge trusses in position, fixing the oil boom panels and the stepping of the main gates.

The addition of the rubber fendering, handrailing, bollards and lamp standards completed the work.

The main contractor for the discharging depot was Messrs. G. Tate and Son Ltd. of Rotherhithe, and the gate operating gear was supplied by Messrs. Clarke, Chapman and Co. Ltd. of Gateshead. The Consulting Engineers were Messrs. W. H. S. Tripp and Partners, of Newcastle-upon-Tyne.

Water Pollution Research

Report for Year 1957

In their Annual Reports for 1957, published on the 1st of this month, the Water Pollution Research Board and the Director of Research, review the work of the Laboratory during the year. Among the subjects dealt with are the further study of the condition of the Thames Estuary, the breakdown of detergents during the treatment of sewage, and the experimental treatment of various trade wastes.

The work on trade effluents is of particular interest in view of the announcement in the Board's Report of the formation of a joint committee of the Water Pollution Research Board and the Federation of British Industries to advise on problems of pollution in which industry is particularly interested. The Federation is to make a substantial financial contribution to the work of the Laboratory and a considerable expansion in the programme of research on industrial wastes is expected.

Brief summaries of the results of the chief investigations made during 1957 are given below.

Survey of the Thames Estuary

Since it has been shown that the present sanitary condition of the Thames Estuary can be predicted with reasonable accuracy from a consideration of the present polluting load and other factors, these methods have been used to assess the changes which would occur if certain palliative measures were taken. In

Water Pollution Research—continued

some parts of the estuary, particularly in the region of London Bridge, a significant increase in the concentration of dissolved oxygen would occur if the cooling water from the most important electricity generating stations were aerated before discharge. The effect of addition of a given weight of oxygen to the estuary in this way would be approximately the same as that from reducing by a similar amount the weight of ultimate oxygen demand in polluting liquors discharged in about the same position. Heating of the central reaches of the estuary, which occurs by the discharge of cooling water, has been shown to have a relatively small effect on the distribution of dissolved oxygen. Information of this kind has been obtained to provide a basis for calculating the most economic means of improving the condition of the estuary.

It is expected that the large alterations and extensions which the London County Council is making to its two sewage works on the estuary will have been completed by about 1962. Calculations suggest that when these improvements have been completed sulphide will no longer be evolved in the central reaches of the estuary, though the concentration of dissolved oxygen will still be very low in this region, and reduction of nitrate will still occur there. The conditions in which nitrate is reduced are still not known with accuracy; results of laboratory experiments agree generally with observations in the estuary in suggesting that it may be reduced at a significant rate when the concentration of dissolved oxygen is as high as 5 to 10 per cent. of the saturation value. There is some evidence to show that this limiting concentration is higher when the temperature is higher.

Oxygen Balance in Surface Waters

The level of oxygenation in a polluted stream depends to a very large extent on the exchange coefficient for the stream, which is a measure of the rate at which the water will absorb oxygen from the air. The variation of this coefficient with temperature has been determined for water flowing through a channel, the value found being considerably less than has previously been reported. Because of the great importance of the exchange coefficient a considerable amount of work has been done on methods by which it can be directly determined for a natural stream. These methods are not at present very satisfactory but the values obtained by using them are thought to be more reliable than those given by methods hitherto used in which it is necessary to make several dubious assumptions. It is now possible to predict with reasonable accuracy the extent to which water is aerated in passing over a weir; both the height and type of weir and the depth of water below it have to be taken into account.

Effect of Pollution on Fish

Metal salts may be discharged to rivers as constituents of industrial effluents, or may be leached from spoil banks associated with mine workings, and a programme of work to determine the toxicity of these salts to fish has been begun with an investigation of the toxicity of zinc salts. The tests so far made have confirmed that zince is more toxic in soft than in hard water and the reasons for this are being investigated; it has been found that calcium chloride reduces the toxicity of zinc rather more than does calcium bicarbonate. Experiments in which radioactive zinc was used as a tracer suggest that zinc may act as an internal poison and not simply by preventing respiratory exchange at the gill surface.

Treatment of Sewage

Experiments on the effects of synthetic detergents on sewage treatment continue; it appears that the presence of such substances in sewage reduces the rate at which oxygen is absorbed in the activated-sludge process. Under certain conditions this effect could explain the reduction in efficiency which is said to have occurred at some works as a result of the introduction of synthetic detergents for domestic use.

Industrial Waste Waters

The biological destruction of cyanide in percolating filters, which has been proved practicable on a small scale, is now being investigated in a pilot-scale filter containing about 2 cu. yd. of medium. The concentration of hydrogen cyanide has been reduced from 60 to less than 1 p.p.m. when the rate of treatment was 720 gallons per cubic yard per day.

A pilot-scale plant is also in operation for treating slaughterhouse waste waters by anaerobic digestion. Over a period of 3½ months the average reduction in B.O.D. (biochemical oxygen demand) varied only between 94 and 97 per cent. in spite of considerable variations in load; the lowest period of retention was about 24 hours.

The process of anaerobic digestion, hitherto little used for treating industrial wastes in Great Britain, is also being tried for treating spent wash produced in the manufacture of whisky. Preliminary laboratory experiments have shown that satisfactory digestion can be obtained if the initial loading is small and is increased only gradually. A reduction of 95 per cent. in the B.O.D. has been obtained with a period of retention of 10 days, and work is continuing in an attempt to reduce this retention period.

Water

To study the possibility of recharging an underground water supply with river water, experiments have been made to determine the changes which occur when a polluted water is allowed to percolate through porous sandstone. It has been found that considerable removal of ammonia and reduction in B.O.D. occurs during percolation through 2-ft. of soil, provided that application is intermittent.

"Water Pollution Research 1957" is published by Her Majesty's Stationery Office, Kingsway, London, W.C.2, for the Department of Scientific and Industrial Research, price 6s. In the U.S.A. the Report can be obtained from British Information Services, 45, Rockefeller Plaza, New York, 20, N.Y., price $1.08.

New Pier Design for Great Yarmouth Harbour

Serious undermining of the foundations at the entrance to Great Yarmouth Harbour—caused by currents and eddies scouring away the harbour bottom—has made rebuilding of the piers essential. To avoid this happening again after reconstruction, the Hydraulics Research Station, of the Department of Scientific and Industrial Research, has solved the problem by altering the design of the South pierhead.

Experiments on a scale model have shown that a curved pierhead will reduce the eddies and fast currents and thus prevent a re-occurrence of undermining to the new structures. In addition, tests with a radio-controlled model ship indicate that navigation through the harbour entrance will be less difficult.

During the nineteenth century, shoaling at the harbour entrance caused a sand bar to form which obstructed navigation. This was overcome in 1872 by extending the North Pierhead to encourage a natural scouring action by the discharge of water from rivers and Broads, and more particularly by the ebb and flow of the tides. But although this removed the sand bar, the scouring caused deepening of the bed over the years; the pier structures were undermined and, at one point in the harbour entrance, a deep hole was scoured in the bed. In addition, decay and wave action had caused further damage and, as a result, it became necessary to rebuild both North and South Piers.

The problem was put recently to the Hydraulics Research Station by Coode and Partners, Civil Engineers, who are consultants to the Great Yarmouth Port and Haven Commissioners. At Wallingford, a model of the harbour and adjoining coastline was built to a scale of 1/120 so that existing conditions could be simulated. In this way it was possible to trace the patterns of eddies and currents which caused the undermining and it became clear that the currents would have to be diverted from their present pattern with the object of producing an eddy-free flow of water round the South Pierhead and into the Haven.

Tests with a curved South Pierhead showed that the tendency to undermine the structure had been eliminated. The new design for the South Pier will cost very little more than rebuilding the existing structure.

British Inland Waterways Developments

1. Hydraulic Dredgers for Narrow Canals

In the July 1956 issue of this Journal an article called attention to experiments with mechanical dredgers which were being carried out on the canals of the North Western Division of British Transport Waterways. Reference was made to further developments of the type of dredger used for these experiments, and we now learn that two hydraulically operated dredgers, the "Beaver" and the "Otter," which have been specially designed for canal work, have now been taken into service.

The dimensions of the "Beaver" are:

Length	...	Pontoon 30-ft. 0-in. Overall 38-ft. 0-in.
Beam	...	7-ft. 0-in.
Draught	...	2-ft. 9-in.
Headroom		6-ft. 9-in.
Displacement		8 tons

The power unit is an Armstrong Siddeley 20/33 air-cooled diesel engine coupled direct to a hydraulic pump delivering approximately 18 g.p.m. at 1,500 p.s.i. The power unit is centrally mounted on the dredger.

The dredging equipment is the MK IV Dinkum Digger manufactured by Messrs. Whitlock Bros. Ltd., of Great Yeldham who also built the dredger and undertook the fitting out. The dragshovel bucket is 10 cu. ft. capacity and the jib operates through an arc of approximately 170°. The digger is mounted over the bow of the craft with the operator's cab immediately behind.

Four stabilising spuds are fitted to the craft each controlled by a hydraulic ram. These spuds which have a maximum stroke of 3-ft. can be rotated through 360°. Horizontal spreaders are attached to the lever ends which when perpendicular to the sides of the pontoon increase the beam by approximately 5-ft. to give added stability under all working conditions.

The maximum digging depth of the dredger is 9-ft. and the maximum outreach 12-ft.

The dimensions of the "Otter" are:

Length	...	Pontoon 30-ft. 0-in. Overall 38-ft. 0-in.
Beam	...	12-ft. 0-in.
Draught	...	2-ft. 9-in.
Headroom		6-ft. 9-in.
Displacement		12 tons

Power unit—Fordson 4D Diesel Industrial Engine developing 50 b.h.p. at 1,800 r.p.m.

This dredger built by Messrs. J. C. Bamford of Uttoxeter is fitted with their new "Hydra Digga" which has a bucket capacity of 12 cu. ft. The jib slews through 180° and is fitted to the bow of the pontoon.

The spud arrangement is similar to that of the "Beaver."

The "Otter" can dredge to a depth of 12-ft. and its maximum outreach is 16-ft.

These dredgers are intended primarily for cleaning the bars at approaches to bridges which are difficult to dredge with traditional equipment because of the nature of the material and the physical restrictions. However, they have been used for normal canal dredging and for back filling behind piles or concrete waterway walls with a good deal of success.

2. Asphalt Lining to Prevent Leakage

Lining works carried out by the Trinidad Lake Asphalt (North Western) Company Limited on the Llangollen Branch of the Shropshire Union Canal have brought about a reduction of 90 per cent. in the amount of water lost by leakage in one short section of the Canal. These figures are the result of preliminary observations made since the work was completed last summer, and are subject to confirmation by detailed measurements taken over a period.

For many years it had been known that upwards of two million gallons of water a day were escaping through fissures in the bed of a 900 yards section of the canal between Chain Bridge and Pentrefelin. Various attempts were made to stop the loss by lining the bed with clay puddle and clay raffle, but in most cases the relief was of short duration.

The use of hot asphalt for canal lining is not very well known in this country, though it has been common practice in America and on the Continent. It was recognised however, that hot asphalt compared favourably in cost with alternative treatments, and it was decided to proceed on an experimental basis.

Before any asphalting could be started, considerable preparatory work had to be carried out. In the first place, 2-ft. of silt had to be dredged away. Secondly, the bed had to be lined with 3-in. limestone, and new side slopes constructed. These were laid at any angle of 35°, and were formed with 1½-in. limestone stabilised with bitumen emulsion. A further two coats of emulsion rendered the surface suitable for the asphalt base course.

The "Beaver" loading spoil into barge.

View of "Otter" showing hydraulic operated stabilising spuds.

One problem was to deliver the asphalt at 300°F. to a remote and inaccessible site 45 miles from the batching plant where it was mixed. In the event, insulated tippers ensured that no heat was lost en route.

The asphalt lining was of two-course construction, comprising a 2-in. Base Course and a half-inch Sand Carpet.

The two side slopes were completed before work on the bed was started. The treatment was carried up to a height of about 1-ft. above the normal water level, and on the towing path side a strip was wrapped over to form the edge. The lining of the bed which followed was carefully planned to ensure that no heavy wheeled vehicles passed over either the Base Course or the Sand Carpet once they were completed. Bitumen was used to seal the joints between the asphalt panels, and to make a bond between the asphalt and rock out-crops, where necessary.

The very considerable measure of success which has been achieved by this lining is undoubtedly due to the impervious nature of hot rolled asphalt when properly laid.

British Inland Waterways Developments—continued

3. Floating Containers

A new and experimental type of floating container which has been evolved for the speedy and economic movement of freight traffic over 100 miles of narrow waterways in the Birmingham area was recently demonstrated to traders and industrialists in the Midlands.

This new container, which has been developed from the compartment boat system of container trains which has proved so successful on the wider waterways of the Aire and Calder Navigation, has been specially designed for the 7-ft. waterways of the Midlands to carry loads which cannot be handled economically by the 25-ton narrow boat. It can be towed by a tug either singly or with others as part of a compartment water train, and can be lifted easily from the water by crane or slipway direct to loading or unloading point, or on to a trailer or other vehicle.

There is at present in the Midlands a considerable volume of short-haul traffic in quantities up to about 2 tons passing between canal-connected premises and for traffic of this kind the floating container system is thought to have real advantages. The need for a high standard of packing is eliminated, there is a high degree of immunity from loss or damage, and the costs of loading, stowing and unloading are minimised.

Five prototype containers—three 7-ft. long, one 10-ft., and one 17-ft., with capacities of 3, 5 and 8 tons respectively, and all of 7-ft. beam to allow passage through the locks of narrow waterways—are undergoing trials at the British Waterways Depot in Birmingham. These prototypes are of plywood construction, but it is expected that when quantities of containers go into production they will be constructed of either fibreglass or aluminium, with bracing and ribbing moulded into the craft to make a light, but strong unit. The lightness would give a low weight ratio to tonnage carried and would facilitate handling. Watertight doors, designed to open outwards, would give easy access for loading or discharge.

Floating containers on a canal in the Midlands.

Towing attachments which slide in slotted tubes to the full depth of the containers allow for trains of containers being loaded at varying depths, and also prevent rolling and turning.

St. Lawrence River Ports and the Seaway

By Brigadier MAURICE ARCHER, P.Eng.
(Chairman, National Harbours Board, Canada).

The St. Lawrence Seaway is mainly a 135 mile stretch of the St. Lawrence River west of Montreal, consisting of a system of 7 locks, canals, and dredged channels with a depth of 27-ft., which will replace the present 14-ft. draft channel having 21 locks. This expanded route will be in existence in the spring of 1959.

What is being done to the St. Lawrence River ports to meet new demands created by this greatly expanded channel?

The three major ocean ports on the St. Lawrence River, i.e. Montreal, Quebec and Three Rivers, are under the jurisdiction of the National Harbours Board, Canada. Major changes and additions to these harbours, to fit them efficiently into the Seaway picture, will entail an expenditure upward of $70,000,000. Changed methods of grain transportation on completion of the Seaway and normal growth of the national economy are the main factors which have brought about this extensive development programme. If the new Seaway route opens the Lakes to larger ocean carriers, it should also be remembered that the giant lake vessels that now ply the Lakes will be able to reach the lower St. Lawrence ports.

The large lakers are 700-ft. long, have a beam of 80-ft., a draft of 27-ft., and a capacity of over 700,000 bushels of grain. At present they are land-locked in the Lakes. Grain carrying is their main trade. They load this commodity at the head of the Great Lakes—Port Arthur and Fort William—and have to discharge their loads into elevators located along their route to the St. Lawrence River for transfer to smaller ships — canallers. The canallers have a draft of 14-ft. and a maximum capacity of 100,000 bushels and transport their loads from the intermediate elevators to the ocean ports on the St. Lawrence River.

The extension of the operations of the large lakers to the St. Lawrence River ports upon completion of the Seaway will result in the saving of one handling of the grain. In addition, the large lakers are very

West side view of Jetty No. 1, Montreal Harbour.

St. Lawrence River Ports and the Seaway—continued

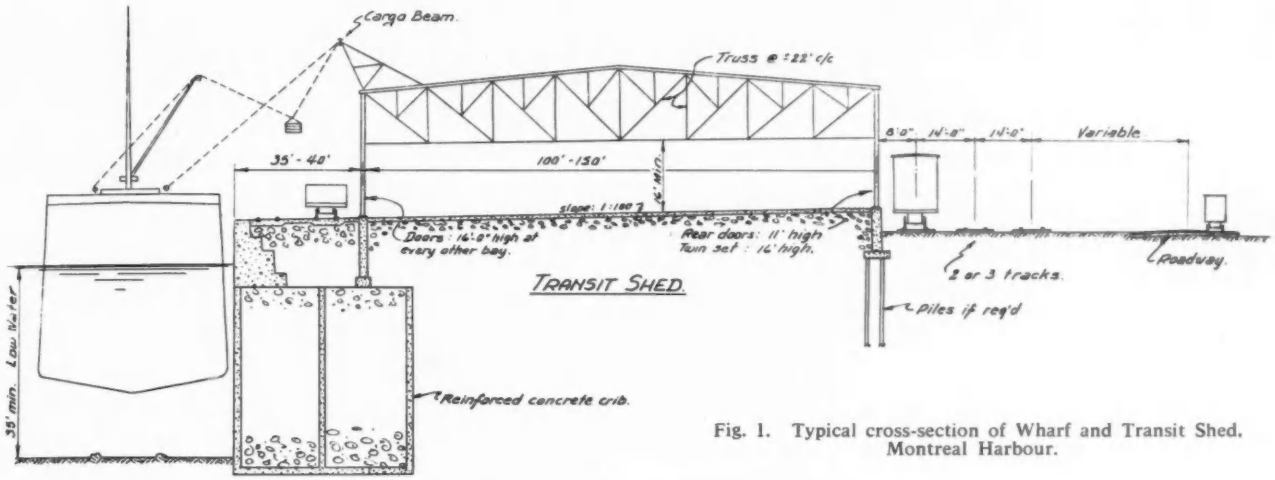


Fig. 1. Typical cross-section of Wharf and Transit Shed, Montreal Harbour.

economical to operate. It is difficult to forecast the actual saving in transportation costs, however, it has been estimated that it will run between 3 to 5 cents. a bushel from the head of the Lakes to the St. Lawrence ocean ports.

Montreal Harbour

In 1957, a $57,000,000 programme of capital works in the Port of Montreal was approved by the Government on the recommendation of the National Harbours Board. The new works are planned not only to accommodate the increase in transhipment traffic, which the Seaway is expected to create, but also to serve the needs of the rapidly expanding economy of the Montreal area. In detail the programme calls for expenditures of $27,000,000 on the grain elevator system, $17,000,000 on wharves, $5,000,000 on transit sheds, $7,500,000 on dredging and $500,000 on minor items.

The grain elevator system is being adjusted and enlarged to accommodate large lake carriers, as compared with the present small canaller. Four berths will be equipped to unload these large lakers in less than 15 hours. New marine towers will have an unloading capacity of 36,000 bushels per hour each. The towers will be equipped with pneumatic cleanup-equipment to replace the shovels normally used to scoop the grain to the boot of the leg after the dip. It will be the first time that pneumatic unloading has been used at grain elevators of the National Harbours Board. The capacity of each suction plant will be 12,000 bushels per hour of grain weighing 60 pounds per bushel. The grain elevators will, where new scales are required, be provided with Printweigh Automatic scales, each of a capacity of 36,000 bushels per hour. They are the latest proven type for efficient and rapid weighing.

The storage capacity of the Montreal elevators will be increased by 6,600,000 bushels bringing the total to 21,762,000 bushels. In brief, the storage capacity will be increased by 44 per cent. and both the unloading and loading capacity by about 80 per cent. The Port of Montreal will be equipped to receive and deliver 300,000 bushels of grain a year.

General view—Reinforcement of tunnel slab of second crib. Framework and reinforcement of flooring of sixth crib, Montreal Harbour.

Additions to wharf facilities include one new grain unloading jetty, 700-ft. long; 9,800 linear feet of new wharves to handle increased bulk traffic, such as cement and petroleum products, and general cargo; and the raising of two low level wharves on which to build new sheds and grain galleries.

Fig. 1 illustrates the general type of construction used for wharves and transit sheds. Essentially, the wharf consists of reinforced concrete cribs each about 48-ft. wide by about 112-ft. long, and of variable depth depending on the range of tides —for instance for a 35-ft. berth in Montreal the height of the cribs is 43-ft. whereas in Quebec, for the same depth of berth, it would be 50-ft. This huge concrete box rests on a crushed stone mattress and is surmounted by a concrete copewall. Gravel is used to fill the cribs and for backfill of the copewall and the cribs. Aprons are 40-ft. wide when sufficient area is available, thus providing sufficient space for two lines of railway tracks.

Expenditures of $5,000,000 for transit sheds cover three sheds, each with clear area of 75,000 square feet; the extension to two existing sheds, and a particularly large shed, 1,500-ft. long by 100-ft. wide, to

St. Lawrence River Ports and the Seaway—continued

be used as a package freight terminal. Total additional floor area will be approximately 590,000 square feet, a net addition to shed floor area in the harbour of about 23 per cent.

Main features of the transit sheds are (a) single storey clear span steel trusses varying in width from 100 to 150-ft. depending on the area available on the wharf or pier and the purpose for which it is intended; (b) front doors are usually of the vertical lift turn-over type, they are 16-ft. high by about 19-ft. wide and are installed at every bay or alternate bay depending on the width of the apron; (c) rear doors are continuous, 11-ft. high except for two twin sets at 1/3 points which are 16-ft. high; (d) minimum clearance under the trusses is 16-ft.; (e) the rear of the shed is elevated to allow direct handling from or to railway cars or trucks; (f) the floor slopes from the rear of the shed to apron level on the water side; (g) at each end there are doors for tailgate loading and unloading of trucks, and there is also at each end a large door for truck traffic; (h) sheds are provided with offices, gear rooms, water, etc. At the rear of the sheds there are two or three lines of railway tracks and a wide roadway.

Dredging expenditures are to provide approach channels to new wharves, to enlarge the turning basin and to deepen existing channels.

Quebec Harbour

Expenditures in Quebec Harbour will amount to approximately $10,000,000, consisting in improvements and additions to the grain elevator system, to the wharves and to the transit sheds. A fast unloading grain berth, similar in design and equal in capacity to the Montreal berths, will be built. New grain unloading marine towers at this berth will have pneumatic unloading equipment of the same capacity as that proposed for Montreal. The addition of 2,000,000 bushels of grain storage capacity will bring the total storage to 6,000,000 bushels. As in the case of Montreal, Printweigh Automatic scales will be installed in the grain elevator.

1,600-ft. Wharf at Sections 50-53, Montreal Harbour. Construction of the copewall and fill.

The construction of a new oil wharf will relieve the terminal at Wolfe's Cove of tankers, and permit use of the freed berthing space for passenger ships and cargo. A berth will be reconditioned and a new shed built for package cargo. The oil wharf is steel sheet piling of cellular construction consisting of a series of circular cells of piling 62-ft. in diameter filled with suitable material, connected by short arcs interlocking with fabricated " T " sections. The contractor used Senelle piling produced at Longivy-Bas, France, which was shipped directly to the site of the work. A straight web section 16-in. x ½-in. with separate interlock was used. The longest pile was 74-ft. in length. Inspection of the steel was made in France.

Quebec, the last ocean port-of-call before taking to the high seas, is located 350 miles from Seven Islands where millions of tons of Labrador iron ore are now being shipped. It is quite possible that ships from the Great Lakes could unload grain cargoes in Quebec and continue their voyage to Seven Islands to pick up cargoes of iron ore for the return trip to the Great Lakes.

Of considerable interest to the Port of Quebec is the regular coastal service. For the first time in its history, this service has operated during the 1957-58 winter season to all coastal ports on the rapidly expanding north shore.

Three Rivers Harbour

Three Rivers, situated half-way between Montreal and Quebec, is located at the centre of a large industrial area. The expansion works at this port consist of a new clear span shed providing 55,000 square feet of area. Tenders are being called for the extension of a wharf to provide open space for bulk commodities. The Three Rivers Grain Company added storage to its grain elevator last year and is providing a fast unloading grain berth in anticipation of the increased St. Lawrence Seaway Traffic.

About 80 per cent. of the contracts have already been awarded for the programme at the three harbours mentioned.

The National Harbours Board also administers the following ports: Halifax, N.S.; Saint John, N.B.; Chicoutimi, P.Q., Vancouver, B.C.; Churchill, Man. It also administers the Prescott Elevator on the Upper St. Lawrence, 140 miles west of Montreal, and Port Colborne Elevator on Lake Erie, both of these elevators being used for domestic trade and for the transfer of grain from the large lakers to the canallers. There are also major programmes of improvements in these ports but not directly related to the St. Lawrence Seaway.

Aerial view of the Downstream section of the Port of Three Rivers.

The Continental Ferry Service

Adaptation of a Wartime Transport System

(Specially Contributed)

The idea of a Continental Ferry Transport Service was first conceived during the last World War when tank landing ships were used to convey Allied mechanised equipment across the English Channel. Several of the present directors of the Atlantic Steam Navigation Co. Ltd., who had had experience of these ships during this time, considered that they could be adapted for use as merchant vessels employed to carry commercial lorries and trailers across the Channel. Consequently, upon the conclusion of hostilities, the Company acquired seven such tank landing craft from the Admiralty, and these vessels were first used to ferry many thousands of British Army vehicles through the ports of Tilbury and Hamburg.

However, it is in the field of commercial operation that the Service has proved to be a success, and the advantages of the "drive-on, drive-off" principles are being increasingly appreciated by manufacturers and road haulage contractors alike.

Although a service between England and the Continent was envisaged as far back as 1946, a service between Preston and Northern Ireland was the first to come into operation. The factors influencing this decision were, first, the short sea journey and, secondly, the fact that Northern Ireland is part of the United Kingdom, with the result that there are no fiscal, licensing or Customs difficulties to be overcome. Since May 1948, when the Preston/Northern Ireland Service first commenced operation, over a quarter of a million road vehicles have used the service, representing a total of some 2½ million deadweight tons of freight transported. The experience gained in the development of this Service has been of great benefit to the operators in the establishment of the Tilbury/Antwerp ferry service, which was inaugurated in July last year. It has become possible for loaded lorries and trailers to travel as a single unit all the way from manufacturers in Great Britain to customers in one of the Continental countries, and vice versa. A special terminal at Berth 110 in the Port of Antwerp has been constructed to handle the traffic.

Speed is the main factor contributing to the success of the Service, for it is possible to discharge 60 or 70 vehicles and to load a similar number in six hours. As normally each vehicle carries an average of some 8 or 10 tons of cargo, this means that approximately 1,200 tons of cargo can be handled at the terminal within the space of one tide. The fundamental advantages of the Transport Ferry Service are, therefore:

(a) Speed, owing to door to door through facilities
(b) No handling of goods en route
(c) Virtual elimination of pilferage and damage
(d) Less packaging required

While many manufacturers make use of their own vehicles to transport their goods from door to door and, by so doing, obtain all the advantages of the service, other firms prefer to use the specialised service provided by the professional road haulage companies, operating with trailers and containers. These are hauled to the despatching port by tractor units, then unhitched and run into the ship. At the arrival port the trailers and containers are taken ashore and on to their destination by other tractor units. In Antwerp, of course, the function is carried out by Belgian and other Continental road hauliers on behalf of the British trailer owner.

British Road Services

British Road Services have established a special traffic organisation for the Continental services and the Purfleet depot is responsible for vehicle and traffic control. The fleet of vehicles employed consists of A.E.C. Mercury tractors and some three dozen Brockhouse and Crane semi-trailers, which are of two types, box van and flat. The box vans have a capacity of 1,250 cu. ft. and both types of trailer are 23 or 24-ft. long. At Tilbury, the semi-trailers are shunted into the ferry by either B.R.S. tractors or tractors maintained for the purpose by the Regent Stevedoring Company Ltd. No matter which tractor is used, however, the stevedores' driver must be at the wheel in order to comply with port regulations.

On arrival at Antwerp, the trailers are attached to Mercedes-Benz tractors of the road transport department of the Société Belgo-Anglaise des Ferry-Boats S.A., of Brussels, with whom the British Road Services have concluded an agreement. Although at present the S.B.A.F.B. Company haul the trailers from Antwerp to their destination, irrespective of country, it is anticipated that arrangements will be entered into with hauliers in the Netherlands and West Germany, whereby trailers bound for those countries will be handed over at the frontier to undertakings with a more intimate knowledge of routes and conditions. Traffic is so far carried to France, the Benelux countries and West Germany; Switzerland is not yet served because vehicles there are restricted to an overall length of about 29-ft. 6-in.

British Road Services employ Thos. Cook & Son, Ltd. to attend to all transit documentation, both in respect of the trailer and of its load. All orders are dealt with by the B.R.S. London office controlling the service and other branches pass to it all enquiries or orders received.

Boxvan trailer and tractor.

Independent Hauliers

An example of an independent haulier operating a regular Continental service is Continental Ferry Trailers, Ltd. of Barking in the London area. This Company was created specifically to operate the Continental service pioneered by I. Leftley Ltd. and is one which regularly uses the Tilbury/Antwerp ferry. The firm operates semi-trailers jointly with those of its Netherlands associate, H. W. Konig & Co. of Rotterdam; the trailers being placed in a pool without restrictions.

The first trailer was despatched by Leftley in May last year after eighteen months of preparation and, from a commencement with one articulated vehicle, there are now eighteen trailers in commission each company operating half that number. The Leftley trailers are mainly maximum capacity 26-ft. long models, built by the British Trailer Company Ltd. and have flat platforms. The latest examples have four-in-line rear wheels, are eight feet wide and are rated to carry up to 16 tons. The Konig trailers are all special types; 10 to 25-ton low loaders with four-in-line or tandem axle rear bogies, flat platforms up to 33-ft. long and two-wheeled dollies with turntables for long loads. For their traction, there are four Atkinson tractors available in this country and about a dozen Bussing or American type tractors in the Konig fleet.

By agreement, a Belgian haulier company, West Friesland N.V. of Antwerp, acts as sub-contractor when necessary, and both the Continental companies operate on international routes, Konig working throughout Europe.

It is claimed that, except for the first experimental trip, no trailers have travelled empty on the ferry. About one-third of their time is spent awaiting loads and the total turnround time is about fourteen days. In this connection, it must be noted that as journeys are made so far afield, some delays in co-ordinating

The Continental Ferry Service—continued

orders and available trailers are inevitable. The wide variety of trailers in use however, assists in dealing with diverse traffics.

If requested, the haulier companies also undertake Customs documentation and attend to the required formalities, thus speeding up the clearance of goods. Forty eight hours' notice is expected for traffic from Britain to the Continent but, on several occasions, half a day has sufficed. One of the fastest transits recorded was a consignment loaded overnight in Leicester and delivered 36 hours later at Ste. Nicolas, ten miles from Antwerp.

Type of Traffic

Much of the traffic leaving Britain for the Continent is machinery, not necessarily in large pieces but all subject to heavy packing costs if despatched by sea in the normal way. The 1958 International Exhibition in Brussels provided many useful loads in the development stage. The cost by trailer service is normally rather higher than by cargo ship but most users find that this is more than offset by reduction in packing costs. Also, return loads are on the increase, and some of the most enthusiastic users of the Service so far have been the flower bulb growers of Holland. Nylon yarn, reeled but without protective packing and asbestos sheets are examples of cargo which benefit from minimum packing.

T.I.R. Carnet

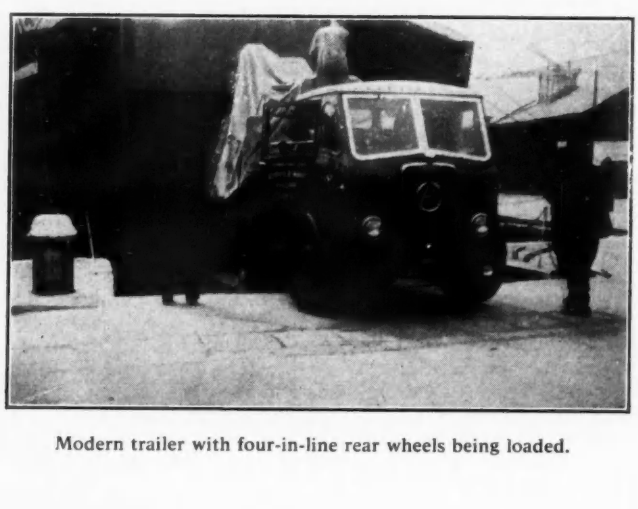
The international movement of motor vehicles between Great Britain and the Continent is governed by the terms of a convention of 1954, which admits vehicles on what are termed "temporary importation papers" and prescribes a procedure to allow the international transport of goods without breaking of bulk across one or more frontiers and without examination, en route between Customs offices of departure and destination.

Carriers operating regularly on the ferry service can arrange to furnish their trailers with a **carnet de passages en douanes,** which authorises its temporary admission abroad without payment of import duties or taxes. The carnet is issued in book form, with tear-off sections for each exit and entry at a Customs point; one book is reserved for each trailer.

Provided that they are carried in a covered vehicle meeting the correct constructional requirements, goods exported from the United Kingdom to a destination beyond Belgium can be moved without repeated examination at Customs points. As Britain has not yet adhered to this part of the 1954 convention, a special temporary procedure is carried out at Antwerp where the carnet T.I.R. comes into force.

To qualify for the T.I.R. carnet the sides, floor and roof of a box vehicle must be of metal plate welded or riveted, or of grooved boards, so that access cannot be gained to the interior without visible traces of damage, and there are special requirements as to bolts and rivets and the construction of the rear doors, which must not be so mounted that they can be lifted off their hinges.

Tilt van bodies are permissible; the tilt must cover the headboard and the sides and tailboard so as to render the load inaccessible. A certain minimum height is stipulated for the fixed sides and tailboard. Goods carried on open vehicles cannot be accepted for the carnet T.I.R.; instead the carrier must enter into a bond in respect of the full value of the load.



Modern trailer with four-in-line rear wheels being loaded.

Articulated trailer carrying a typical load.

In search of a more economical way of dealing with heavy loads which do not occupy all the platform space, investigations are now in hand on the design of removable extensions to the trailers or even telescopic frame members with platform sections which can be lifted out when not required, thus enabling the maximum weight to be carried at the lowest possible cost.

Frequency of Sailings

Sailings on the Tilbury/Antwerp ferry are now three times a week, departing from Tilbury at 2 p.m. or 3 p.m. on Monday, Wednesday and Friday. The Service is developing rather faster than anticipated and at present two vessels, the "Empire Baltic" and the "Empire Celtic" are in commission. The journey occupies about 18 to 20 hours, and the sailings in the reverse direction are similarly timed. The charge for loaded vehicles is on the basis of deck area occupied, with reduced rate for empty vehicles.

New Container Vessel for Heysham to Belfast Run

A new type of vessel made its maiden voyage last month from Heysham to Belfast carrying railway containers of various types. She is M.V. Container Enterprise, the first of two such vessels ordered by British Railways (London Midland Region) for the Northern Ireland Service.

The new vessel, with a capacity for at least 65 large containers, will improve the service which has transported more than 105,000 containers between Heysham and Belfast in the last 5 years. During that time the traffic has grown from a total of 17,243 in 1953 to 25,225 in 1957. With the aid of new cranes and appliances at Heysham and Belfast, now in course of installation, it is considered that loading and unloading of containers will be speedier than the roll-on roll-off method.

The design of the Container Enterprise was evolved as a result of study of existing foreign and British container carrying vessels. Large MacGregor sliding hatches are a feature, allowing the containers to be lifted and laid direct in place in the holds. A deadweight of about 600 tons on a loaded draft of 10-ft. 9-in. will be carried. Her principal dimensions are: length B.P. 245-ft., beam 40-ft., depth to main deck 14-ft. 6-in., depth to shelter deck 22-ft., gross tonnage 982. Derricks are not fitted as the cargo will be loaded and discharged by dockside cranes. Navigational equipment includes Decca navigator, Kelvin Hughes radar, echo sounder, electric log and radio telephone, as well as the usual outfit of compasses and nautical instruments. The propelling engine is an M 48 M Polar diesel capable of developing 1,500 b.h.p. at 300 r.p.m. to give a service speed of 12½ knots.

The vessel was built by the Ailsa Shipbuilding Company of Troon, and a second ship of similar type is in an advanced stage of construction at the same shipyard. This Company also have an order from British Railways for a new cargo/container ship for the Irish Sea Services.

Personalia

Appointments

Mr. John Ronald Sainsbury, E.R.D., M.I.C.E., Assistant Chief Engineer, Tyne Improvements Commission, has been appointed Chief Engineer to the South Australian Harbours Board. With his headquarters in Adelaide he will be responsible for the engineering projects and maintenance in five major ports and in fifty lesser ports along the South Australian seaboard.

Mr. Sainsbury, who was born in London, was trained under the Chief Engineer of the Great Western Railway Company and took up his first docks appointment at Barry Docks in 1930 as Assistant Engineer in the office of the Divisional Docks Engineer, South Wales (East). On the outbreak of war in 1939, as an Officer of the Royal Engineers Supplementary Reserve, he was called up and for six years was engaged on port construction and repair work, rising to the rank of Lieutenant Colonel. One of the projects he worked on during this time was the Mulberry Harbour project, and for his work in repairing dock gates and locks at Flushing, he was mentioned in despatches and made a Knight of the Order of Orange Nassau. At the end of the war, Mr. Sainsbury became Port Civil Engineer (West Baltic Ports) for the Allied Control Commission and then on demobilisation returned to Great Western Railways as dock engineer at Newport.

He joined the Tyne Improvement Commission in 1947 as engineer for Tyne Dock, Albert Edward Dock and Northumberland Dock, and two years later was appointed to his present post of assistant chief engineer. He expects to relinquish his appointment with the Tyne Improvement Commission in early June and take up his new duties in Adelaide during July.

Major General G. N. Russell, C.B., C.B.E., General Manager of British Road Services, chairman of the British Road Services Board of Management, and a member of the Eastern Area Board of the British Transport Commission, has been elected President of the Institute of Transport for the year 1958-1859.

Gen. Russell became a member of the council of the Institute in 1953, and has been a vice-president since 1955. He has served on the membership committee from 1953 and has delivered many papers, including the Henry Spurrier Memorial Lecture to the Institute last December, the subject being "Transport and the Commonwealth."

Gen. Russell was educated at Rugby and the Royal Military Academy, Woolwich, being commissioned into the Royal Engineers in September, 1918. Between the two wars, his military duty took him to India, Iraq and Canada. He specialises in transportation and was attached to the Great Western and London and North Eastern Railways for periods of 12 months. He commanded the 8th Railway Company, Royal Engineers for three years.

Amongst his many duties in the last war he was director of movements in the Middle East and later responsible for all military transportation in India. After the re-occupation of Singapore, he was transportation adviser to the Special Commissioner in South East Asia. He was made a C.B.E. in 1943 and C.B. in 1946 for his services in India and the Middle East.

Mr. A. E. Seddon, M.Sc. and Mr. R. C. H. Russell, M.A., A.M.I.C.E., A.M.I.Mech.E. have been appointed Senior Principal Scientific Officers at the Hydraulics Research Station, Department of Scientific and Industrial Research, Wallingford.

Mr. Seddon becomes Assistant Director, succeeding Mr. Fergus Allen who was promoted to Director of Hydraulics Research on April 1 last. Mr. Seddon, who is at present a Principal Scientific Officer at the Building Research Station, has previously had considerable experience in hydraulics. He is a graduate of Manchester University where he was a Beckwith Scholar, Greatorex Scholar and, later, assistant lecturer in engineering under Professor A. H. Gibson. He did research in hydraulics and structures in the Manchester School made world-famous for hydraulics by Osborne Reynolds and Professor Gibson. Since joining the staff of the Building Research Station in 1946 he has been concerned specially with research on reinforced concrete structures.

Mr. R. H. C. Russell, who has been at the Hydraulics Research Station since it was opened, will have responsibilities for research on wave action, the design of harbours and breakwaters, and research into coast erosion and protection. He is a graduate of King's College, Cambridge. After three years' apprenticeship with the British Thomson-Houston Co., Rugby, he spent three years with the Dunlop Rubber Company where he was engaged in the development of vibrating insulating devices. In 1949 he joined the D.S.I.R. and assisted in the design of equipment for the new Hydraulics Research Station at Wallingford. Among the first officers to join the new station in 1951 he has since been concerned principally with the study of waves and their actions on beaches and harbours. He is joint author, with Commander D. H. MacMillan, of "Waves and Tides," published in 1952, and has also published several important papers on this and allied subjects.

Retirement

Mr. John Wilson retired last month after 23 years' service as general manager and secretary to the Clyde Navigation Trust.

Mr. Wilson, who is 66 years of age, is a native of the Dumbarton area and has been associated with docks, harbours and transport throughout his working life. He was, from 1914 to 1929, on the legal staff of the old railway undertakings, first with the Caledonian Company and later with the London, Midland and Scottish Railway. His duties were concerned with the administration of the various dock and harbour undertakings which were part of the railway organisation.

In 1929 he was appointed clerk and legal adviser to the Commissioners for the Harbours and Docks of Leith and, three years later, became assistant to the general manager and secretary, Mr. James Macfarlane, of the Clyde Navigation Trust. He succeeded Mr. Macfarlane three years later.

He has occupied many other offices in subsequent years. For about 18 months at the beginning of the last war, he acted as Regional Port Director for an extended area which included the war-time port of Faslane within the ramifications of the Clyde Trust. He was created C.B.E. in 1952.

Mr. Wilson has been succeeded as general manager and secretary by Mr. J. R. Proudfoot, until lately general manager and secretary of the Leith Dock Commission.

Obituary

Mr. A. B. Porter. We regret to record the death last month at the age of 58, of Mr. Adrian B. Porter, engineer-in-chief of the Mersey Docks and Harbour Board since 1949. In addition to the general supervision of engineering works on the docks, Mr. Porter was responsible for the £17 million development scheme at the Canada and Langton Docks.

During his 42 years' service with the Board, he was engaged on the design and construction of all the major harbour works undertaken in the port. In 1929 he was appointed engineer in charge of the construction of the foundations and the subsequent erection of the five bascule bridges on the dock estate at Birkenhead. This work was followed by the construction of the reinforced concrete quays at Bidston Dock, and other bridges.

In 1937 he was appointed engineer in charge of new work, his first task being the Waterloo river entrance lock and contingent works. He continued in this capacity until all new work was stopped due to the Second World War.

In 1941 he was appointed assistant to the engineer-in-chief and, in 1943 he became principal assistant. In the latter position, he was engaged on the design and construction of war-time emergency repairs, the completion of the Waterloo river entrance and the post-war construction of sheds and quays.

Mr. Porter was a member of the Institutions of Civil, Mechanical and Structural Engineers and of the Engineers' Sub-Committee of the Dock and Harbour Authorities' Association. He was also a member of the Dock and Harbour Engineering Joint Committee of that Association and a member of the British Transport Commission. He held the rank of Colonel in the Engineer and Railway Staffs Corps. R.E. (T.A.) and was a Member of the Board of Governors of the Liverpool Collegiate School and Birkenhead Technical College.

Mechanical Handling Exhibition and Convention

by our Special Correspondents

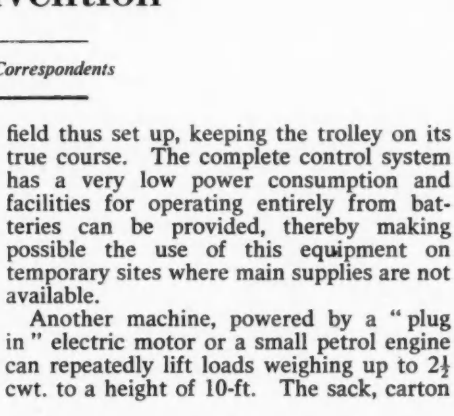
The 1958 Mechanical Handling Exhibition, which is being held at Earls Court, London from May 7—17, is claimed to be the largest display of labour-aiding equipment and methods ever presented to the world. It was officially opened by the Rt. Hon. Viscount Chandos, P.C., D.S.O., M.C., chairman of Associated Electrical Industries.

Occupying half a million square feet of floor space, the Exhibition is for the first time international in character including, apart from the vast range of equipment displayed by British manufacturers, exhibits from overseas from countries such as the U.S.A., France, Belgium, Germany, Italy and Scandinavia. Buyers are therefore able to compare the best equipment made in Great Britain with that produced by countries abroad. The Exhibition embraces a comprehensive range of mechanical handling plant from large-scale installations involving complete factory layouts to all forms of portable units, such as fixed and portable conveyors, cranes, trucks, stackers, hoisting appliances and bulk handling equipment.

A Materials Handling Convention is running concurrently with the Exhibition and speakers from five different industries—all of which are large users of mechanical handling equipment—are addressing the meetings. Among the papers being read are "Automation and Mechanisation — Their Effect on Labour Relations," "Application of Mobile Equipment in Power Stations," "Operation of Storage and Distributing Warehouses," "Focussing the Materials Handling Target" and "Mechanisation Problems in the Port of London." A special programme of industrial films on various aspects of mechanical handling is also included.

In viewing the Exhibition, one is impressed by the developments which have taken place in the two years since the last display. The modern emphasis is on increased elimination of the human element in the handling of loads, and an extended use of conveyor belt systems and electronic controls. In this latter respect, an interesting example is the British designed and manufactured electronic remote and independent controlled Robotug. This represents a completely new system by which driverless industrial trucks automatically move materials from place to place in factory or warehouse. The method of control is simple and yet safe. Electronically controlled from a remote panel, the truck follows an ordinary electric wire—either taped to the surface for temporary routes or laid just beneath the flooring if it is to be permanent—over its desired route. Two sensing coils fixed to the front of the trolley pick up signal currents from the magnetic field thus set up, keeping the trolley on its true course. The complete control system has a very low power consumption and facilities for operating entirely from batteries can be provided, thereby making possible the use of this equipment on temporary sites where main supplies are not available.

Another machine, powered by a "plug in" electric motor or a small petrol engine can repeatedly lift loads weighing up to 2½ cwt. to a height of 10-ft. The sack, carton or similar load is placed on a platform which lifts automatically and halts at any desired level. Immediately one load is removed, the platform returns ready to receive the next. The lifter counts as it works and can be set to stop when any predetermined number of loads has been lifted.



Coles crane Model R.5010.

Yet another exhibit demonstrates how electronics can be used in a commercial warehouse. Packages, which can be released either automatically in a preset rotation or manually by means of push button selection, move through a swing tray elevator which operates so as to combine three lanes of packages on to one belt. An automatic spacing device ensures that the packages are spaced regularly. They then flow on to an electronic weighing machine and the weights are printed out on a teleprinter for permanent record. The weighing device has an indicator board adjacent to it on which are recorded the weights of each parcel to the nearest half ounce and also the total number of packages passing. After weighing, the packages pass on to a coded route selection device which employs a bank of photoelectric cells to read a black and white binary code fixed to each package. By means of this coding system, any conveyor path can be selected.

Standing in the forecourt of Earls Court, an effective symbol of the great industry, is a diesel-electric locomotive crane with a jib radius of 150-ft. After the Exhibition, this crane, which is claimed to be the largest of its kind in the world and weighs 85 tons, will be shipped to India where it will be used in the development of the large Durgapur steelworks.

Another impressive feature of the Exhibition is the main stairway built from slotted angle. The design incorporates two identical staircase units, each 35-ft. high and over 4,000-ft. of punched steel was used in the construction.

Great advances have recently been made in the use of mobile cranes for ship to shore handling of cargo. One exhibit shows a diagrammatic model of such a crane, fitted with a patented controlled cranking jib which enables it to lift over the side of a ship standing high above the quay. Other exihibits feature a range of mobile cranes for dockside work and also small forklift trucks for use in the ships' holds.

A product of interest is the Hydroist electro-hydraulic wire rope hoist, which is claimed to be extremely smooth in operation. To prove this, demonstrations are given showing a load being lowered on to an egg without breaking it.

An interesting exhibit for the dock and harbour engineer is the working model and diagrams for a new mechanical slipway. Intended for the overhauling of large tankers, this consists of a slipway equipped with a series of flangewheel carriages fitted with keel blocks, which run down from the shore on to a thick concrete runway beneath the water. A series of buoys or siting poles are located in the water so as to form a plainly visible "run-in" on to the slipway. The vessel arrives at high tide and is anchored to the correct buoy. As the tide recedes, the tanker slowly lowers on to the keel blocks below. When completely settled, it is hauled up the slipway on the carriages. The motive power is supplied by electric motors which are located in pits well above high water level. The use of the slipway is restricted to tankers of up to 50,000 tons displacement.

Extensive range of Cranes

Coles R.5010 Diesel-Electric Crane

Steels Engineering Products Ltd. have recently announced the introduction of a new range of 15 cranes of 6 to 45 tons capacity. The machines are of three types, self-propelled, truck-mounted and shunting locomotive cranes. Included in this range is the R.5010, a heavy duty, rail mounted, diesel-electric shunting locomotive crane which will lift 45 long tons at 12-ft. radius with a 50-ft. centres strut jib. This crane incorporates many improvements in crane design, including the new ball bearing slew ring and pilot switch control.

The crane revolves on large diameter rings of double ball bearings running in hardened races, obviating the need for a centre post and also giving more even distribution of loading on the chassis frame. Each motion of the crane is controlled by

Mechanical Handling Exhibition and Convention—continued

an interlocked pair of heavy duty contactors operated by pilot switches conveniently located in a console in the driver's cab. For driving, the pilot switches are engaged for the desired motions while the engine is running at reduced speed. Thereafter, speed of motion is controlled through the engine accelerator.

The simple heavy duty contactors are housed in an accessible position at the base of the crane superstructure.

New Truck Crane

Thomas Smith and Sons (Rodley) Ltd. who have been manufacturers of cranes for more than 100 years, have recently developed an entirely new truck crane, the M.E. II. The crane has a separate revolving superstructure which is powered by a 4-cylinder Ford 4D diesel engine, developing 40 b.h.p. at 1,600 r.p.m. The totally enclosed machinery has a pump oil circuit and the hoisting gear incorporates the recently-introduced Smith patented power-lowering mechanism, which gives accurate control on any delicate positioning operation. The crane carrier itself is an A.W.D. Ford chassis with either 6 by 6 or 6 by 4 drive, powered by a Ford 6D diesel developing 100 b.h.p. at 2,500 r.p.m. The drive is through a 4-speed gearbox with an independent propeller shaft to each axle. The carrier frame is a rigid welded structure incorporating outriggers for additional stability when dealing with the maximum load of 8 tons. The basic boom, with 25-ft. centres, can be extended to 65-ft. by the addition of intersections and, as well as its normal crane duties, the machine is designed to operate ½ cu. yd. capacity digging equipment.

NR40 electric fork-lift truck.

Improved Mobile Crane

An important feature of the Jones KL. 66 manufactured by the 600 Group Ltd. is the delicacy of control and the fast, powerful handling over extended periods. Rated at 6 tons at 10-ft. radius, the machine has a hoisting speed of 40-ft. per minute and is powered by a Perkins P.4 engine through a three-speed gearbox. Swan-neck and strut type jibs are available in lengths from 20-ft. to 65-ft.

This mobile crane is available with four-wheel steering. Three other types of wheeled chassis are optional; direct drive, two-wheeled differential and four-wheeled differential drive.

Twin Motor Hoist Control System

Metropolitan-Vickers Electrical Company Ltd. have designed a system of A.C. hoist control employing two identical inducting motors, each of approximately 65 per cent. of the horsepower required and both permanently geared to the hoist motion and running at the same speed. The use of both motors in conjunction gives hoisting and lowering creep speeds varying little with the load, slow light hook speeds and electric braking when lowering. Driving is from either a seated or standing position depending on the situation of the load.

New Cross-Roll Slewing Ring

Priestman Brothers, Ltd. have recently designed and manufactured in conjunction with British-Timken, Ltd. a cross-roll slewing ring and this is now available to crane manufacturers. It is designed to provide perfect load distribution, high tipping moment resistance, and to sustain radial and axial loads in both directions.

Fork Lift Trucks

The Ransomes NR40 Fork Lift Truck

A new fork lift truck, the NR40 which is the largest model to date of its series, has recently been introduced by Ransomes Sims and Jefferies, Ltd. It has a capacity of 4,000 lbs. at a load centre of 24-in. or two tons at 20-in. and is equipped with an Exide Ironclad 18 TLU 23D battery, thus having an extremely generous power/weight ratio. Special attention has been given to the fork profile and all surplus metal has been discarded to give a fork section with maximum strength at minimum weight. It is a compact machine with its turning circle reduced to the absolute minimum, so that right-angle stacking is possible in an aisle width of only 8-ft.

The truck has been fitted with a dual speed motor allowing the top speed unladen to be reduced from 5.5 m.p.h. to 4.5 m.p.h. This enables it to conserve its power without wastage in varying floor conditions, a diverter can be fitted as an optional extra to give a fifth speed and, in conjunction with the slow speed motor connections, this will give the most economical operation where the truck is working in both open and confined conditions. A maximum lift height of 14-ft. is available, at which height the carrying capacity remains unchanged.

Fork Truck with Slewing Mast

Among their comprehensive range of fork lift trucks, Ransomes and Rapier Ltd. draw attention to their Super Fork Truck, which has been evolved as a result of a new conception of handling long loads such as timber, steel sections or pipes. The machine looks like an ordinary fork truck but the mast is arranged to swivel to one side, thus enabling the load to be carried end-on, in line with the direction of travel of the truck.

It picks up its load and, with a combined steering and slewing manœuvre, withdraws it from a line of sets so that it finishes with

Ransomes and Rapier Super Fork-Lift Truck, showing manoeuvring ability in confined space.

the load carried to the side, thus presenting a minimum width for travelling and a minimum effective length for manœuvring.

The slewing mast has an advantage in that it enables the truck to pick up set after set lying one behind the other. In other words, it can enter a transverse lane between sets, pick up a load at the end, back out with it into the main gangway, and manœuvre into its travelling position with the load alongside. The only other way of carrying out this movement and keeping gangways narrow is by lifting the load into the gangway, transporting it either by straddle carrier or trailer, and then re-handling the load at its destination.

The truck is fully powered for hill climbing and has a road speed of up to 20 miles per hour, while the patented self-steering eliminates driver fatigue particularly when manœuvring at low speed. The machine has a lifting and carrying capacity of 12,000 lb. at 24-in. from the face of the forks and is large enough to load a lorry from one side. It has a turning circle of only 12-ft. 3-in. radius, even when carrying a 21-ft. load.

Range of Swedish Fork Lift Trucks

Thos. W. Ward, Ltd., who are the sole distributors in the United Kingdom for "Jimmy" Swedish manufactured trucks, now show for the first time in this country two of the range. Model RSR, which is described as a reach fork truck, has a 2,200 lb. capacity with 100, 120 and 130-in. lifting heights (standard) and has a mast which can be expanded foreward 29-in. for picking up as a fork lift truck.

Model GS. 1000 is a pedestrian fork truck with capacities from 1,100 lb. to 2,200 lb.

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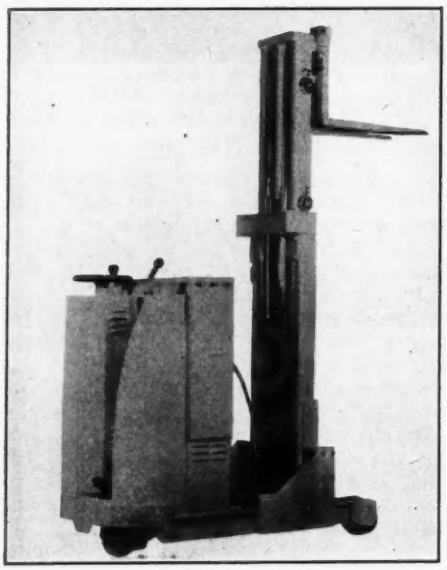
and with 100 and 120-in. lifting heights.

Electrically Powered Stacatruc

The most interesting machine of the new range of trucks recently shown by I.T.D. Ltd. is the 6,000 lb. capacity electrically propelled Stacatruc. This forklift truck when mounted on pneumatic tyres is capable of handling loads over terrain hitherto considered impossible for battery powered vehicles. It will undoubtedly be useful in dock and harbour work, where it is sometimes necessary to move from smooth warehouse floors to rough outside areas. The truck has a lift height of 12-ft. or up to 14-ft. at reduced ratings. It is powered with a Crompton lead acid battery with a 360 ampere-hour capacity at the 5-hour rate, and both the traction and hydraulic pump motors are Crompton Parkinson totally enclosed 4-pole type.

Direction of the truck is controlled by a forward, neutral or reverse switch lever positioned to the right of the steering column. The accelerator incorporates automatic speed control through four speed steps.



Swedish manufactured "Jimmy" Model RSR.

Loaders and Conveyors

Two-way Hydraulic Loader

The Merton Engineering Co. Ltd. have recently introduced their new mechanically operated Mark V overloader, which has a ¾ cu. yd. capacity bucket and a variable discharge height of between 7-ft. and 11-ft. Also in the new range is a smaller model, the S6 ¼ cu. yd. capacity loader with a variable discharge height of between 6 and 9-ft.

Mastiff Four Wheel Drive and Steel Loader

Mathew Brothers have produced a completely new loader designed for bulk handling of various types of material, which is equally suitable for site work as for use on hard surfaces. With a torque converter, power shift transmission and power steering, this loader has a tractive effort of 14,000 lbs. and is fitted with a 1¼ cu. yd. bucket and equipped with 14-in. x 24-in. Earth Mover tyres.

This model has a very high standard of manœuvrability and is claimed by the makers to be the first British made loader of its type.

General Purpose Loader

A new general purpose loader, the 12H has been introduced by F. E. Weatherill, Ltd. and incorporates several interesting features of design. The adoption of a 40° scoop crowd angle, which is hydraulically controlled by the operator, ensures that the maximum efficiency is obtained with each load. A very low scoop carrying position permits loads to be transported safely at top speed without spilling, while a centrally positioned cab affords the operator a clear all-round view.

The loader has a discharge height of 12-ft. with a good forward reach. High-sides lorries and high hoppers can thus be quickly and easily loaded without special positioning or use of ramps. Scoops range from ¾ cu. yd. to 2 cu yds.

"Corruband" Flanged Conveyor Belting

C. H. Johnson (Machinery) Ltd. have produced a new high capacity high-speed conveyor belt which can handle bulk material such as coal, ballast, etc. at steep angles without the need for cleats or flare-plates, thus eliminating costly trough idlers. The conveyor belting incorporates flanges 3-in. deep and so designed that belts up to 4 ply can be employed on drums as small as 7½-in. diameter. The belting is carried on flat idlers spaced at 4-ft. for materials up to 50 lb. cu. ft. and 3-ft. 6-in. for materials up to 130 cu. ft.

Suction and Discharge Hoses

Included in the range presented by Goodyear Tyre and Rubber Co. (Great Britain) Ltd. of oil suction and discharge hoses for the oil industry is the Thor Super-S smooth bore hose designed for a working pressure of 250 p.s.i. This hose is manufactured with bore sizes of 4, 6, 8 and 10-in., with maximum lengths of 50-ft. for the first two sizes and 35-ft. for the larger bores.

Other hose for the oil industry include a Thor Super Submarine suction and discharge hose, a 204H which is a smooth bore suction and discharge hose designed for petrol and crude oil dock service at a working pressure of 200 p.s.i., and a 90 Submarine hose which is highly crush resistant and is used for sea loading. Also offered is a full range of hose fittings in a variety of styles.

The North British Rubber Co. Ltd. have also introduced a number of new types of hose in recent years, particularly for drilling in oil fields as well as for tanker/shore installations, which demand a high quality suction and discharge hose.

Slings and Lifting Equipment

British Ropes Ltd. have developed a new mechanical wire rope splice, the "Superloop," the sleeve of which is made of specially approved steel and is closed over the tails of a Flemish eye splice, thus making it light, slim and easy to handle. It has been proved to be at least as strong as a well made hand splice and, because of its small dimensions, it can be employed in many applications where more bulky hand and mechanical splices are impracticable.

A specially developed fitting, the "Superloop" stirrup is available to protect the bearing of the eye from wear.

The "Talurit" mechanical splicing equipment has been developed by Cable Covers Ltd. for the forming of eyes or loops in wire rope. It is claimed to effect considerable saving in time and material. This Company also produce the "Talurit' safety sling, an item of lifting equipment which gives complete protection to all types of load.

24-in. wide "Corruband" belt, handling ¾-in. rounded gravel.

Pallets and Stillages

Representative of the many firms manufacturing pallets and stillages for efficient handling and stacking are Fisher and Ludlow Ltd. This firm supply a comprehensive range of pallets as well as stacking frames, adjustable pallet racks and an automatic delivery system for pallets.

A special feature is their tier-rack pallet stacking frame. A set of these consists of two metal frames that quickly snap on to a regular pallet converting it to a single portable pallet rack. The frames are identical in size and are joined at the top centre forming an "X" design, thus giving rigid support to the pallets that rest on them. They are available to fit any size pallet including the standard wooden pallets and the support is provided not only in a vertical direction, but also laterally through the four upright members attached to each pallet.

Tubewrights Ltd. also produce a representative range of stacking post pallets, collapsible crates and stillages, as well as adjustable tubular steel racking. Of particular interest to the dock and harbour industry is their new range of Markussen patented pallets.